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Harvey O'Brien

A
C O U R S E
OF *D. Humphreys Street.*
Anatomico-Physiological
L E C T U R E S
ON THE
H U M A N S T R U C T U R E
AND
A N I M A L O E C O N O M Y ;

Interspersed with
Various Critical NOTES, extracted from Memoirs,
Transactions of Learned SOCIETIES, &c. and
Pathological Observations deduced from the
Dissection of morbid Bodies.

I N C L U D I N G
Whatever is most valuable in the WORKS of all
the eminent PROFESSORS on these Subjects.

P A R T I C U L A R L Y
WINSLOW, HALLER, RUYSCH, MORGAGN,
MONRO, HEISTER.

Illustrated with
An HISTORICAL COMPENDIUM of the Rise, Progress, and
Discoveries, which have been made in the ANIMAL
OECONOMY, gradually traced to the present Time.

To which are prefixed,
TWO ESSAYS on the ARTS of Dissecting, Injecting and
Making ANATOMICAL PREPARATIONS.

V O L. II.

Omne tulit punctum, qui miscuit utile dulci. HOR.

By CHARLES NICHOLAS JENTY, M.A.
Professor of ANATOMY and SURGERY.

L O N D O N ,

Printed for JAMES RIVINGTON and JAMES FLETCHER, at the
Oxford Theatre in Pater-Noster-Row. MDCCCLVII.



A N

INTRODUCTORY LECTURE.

Of the SECRETIIONS.

BELOW each of the first salival Glands, or Parotides, toward the mastoid Apophysis, is fixed a small one of another Kind, differing from the former in Figure, Colour, excretory Duct, and in the Fluid, which it secretes. It is round, and of an even Surface, without Tubercles, and it is the superior of a great Number of Glands of the same Kind, which lie partly below the Interstice between the parotid and maxillary Glands and at different Distances, along the internal jugular Vein, all the Way to the inferior Part of the Neck. We observe among the Glands and upon this Vein a great Number of transparent Vessels, with an Appearance of numerous Valves. The Fluid which they contain is transparent, a little mucilaginous, and is called Lympha.

These Vessels and Glands are likewise termed lymphatic. The Glands are not all equally large, nor equally round, some being oblong, thick, flat, small, &c. The lymphatic

sels go out alternately by one Extremity, from one Gland, and enter by the other Extremity into some other near the former, and both as they go out and as they enter, these Extremities are very much ramified. The Trunk is commonly single, and the Valves are so disposed, as that the Fluid contained in the Vessel can only run toward the Thorax, but cannot return to the Head.

These Glands and Vessels are found in many other Parts of the Body. We meet with them not only in several Parts of the Head, but also in many external and internal Parts of the Thorax, Abdomen, and both Extremities. They accompany the maxillary salival Glands, as well as the Parotides; and there are several spread on the lateral and posterior Sides of the Neck, in the Membrana Adiposa, near the Muscles.

In the Cavity of the Thorax the lymphatic Glands are situated at different Distances on one Side and behind the Oesophagus, especially at the Place which is even with the fifth dorsal Vertebra. I have found some on the anterior Portion of the Diaphragm on one Side of the Mediastinum; and there are others round the Basis of the Heart, in the Fat which lies there. They are to be met with likewise in the Substance of the Membrana Adiposa which covers the Thorax, near the inner Surface, especially about the Clavicles, and in the cellular Interstices of the Muscles which lie on the Thorax.

In the Cavity of the Abdomen these Glands are very numerous, and particularly round the superior Orifice, and on the two Curvatures of the Stomach; on the Capsula of the Sinus of the Vena Portæ; on the cellular Ligament of the Vesicula Fellis; near the Beginning of the Ductus Cysticus; at the Adhesions of the Omentum to the Spleen,

and to the Colon; through the whole Extent of the Mesentery; at the Adhesions of the Meso-colon; behind the Adhesions of these two Membranes to the Vertebrae of the Loins; near the Bifurcation of the Aorta; and along the Iliac Vessels*. There are likewise other such Glands on the Outside of the Abdomen, in the Substance, and toward the Inside of the Membrana Adiposa.

In the superior Extremities of the Body, these Glands lie chiefly under the Articulation of the Os Humeri with the Scapula, in the Cavity of the Axilla. The most considerable lymphatic Glands in the inferior Extremity are toward the lower Part of the Inguina, commonly called the inguinal Glands, to which the Fascia Lata or Crural Aponeurosis gives a Kind of double Capsula, which makes some of them lie very near the Skin, and the rest at a greater Distance from it†.

There are three Sorts of Vessels that now go by the Name of Lymphatics, whereas formerly that Word was used only to signify the transparent Ves-

* If we tie a Pipe into the Substance of the iliac lymphatic Glands, and secure the Orifice of the thoracic Duct near the left subclavian Vein and pour Quicksilver into the Pipe, we fill not only the first and second lateral Veins with all the Glands of the Mesentery, but likewise find sometimes a fine fluid Injection will succeed, as I did about six Years ago in a Child about three Years old.

† As all these lymphatic Glands differ more in Situation, than in Size or Figure, they are commonly enumerated and denominated from the Places already mentioned, where they lie in the following Order. GLANDULÆ PAROTIDES LYMPHATICÆ, GLANDULÆ MAXILLARES LYMPHATICÆ, GLANDULÆ JUGULARES, GLANDULÆ CERVICALES, GLANDULÆ OCCIPITALES, GLANDULÆ CLAVICULARES, GLANDULÆ AXILLARES, GLANDULÆ THORACICÆ, GLANDULÆ OESOPHAGÆÆ, GLANDULÆ MEDIASTINÆ, GLANDULÆ CARDIACÆ, GLANDULÆ VENTRALES, EXTERNÆ, INTERNÆ, GLANDULÆ STOMACHICÆ, GLANDULÆ HEPATICÆ, GLANDULÆ CYSTICÆ, GLANDULÆ EPIPLOICÆ, GLANDULÆ MESENTERICÆ, GLANDULÆ LUMBARES, GLANDULÆ ILIACÆ, GLANDULÆ INGUINALES, GLANDULÆ CRURALES, &c.

fels already mentioned, which accompany the lymphatic Glands. The original Sources of these Vessels are very difficult to be found out; and even their Distribution through the Body has not been sufficiently traced to enable us to describe them particularly in this Treatise, and therefore I must reserve that for the Subject of another. As to their Termination, we are sure that for the most Part they end in the Ductus Thoracicus.

Besides these Vessels which accompany the Glands, there are others of the same Structure found on the several Viscera, where no lymphatic Glands have hitherto been discovered. We meet with them in very great Numbers in the external Membrane of the Liver, and in the Duplicature of the superior membranous Ligament of this Viscus, as shall be observed. Several Discoveries have been made about these Vessels in Brutes, which I here pass over in Silence, the sole Design of this Lecture being to describe those of the human Body.

The third Sort of Vessels termed Lymphatics, are the small Arteries and Veins which in the natural State, transmit only the serous Part of the Blood. These Vessels differ from those of the first in the Smalness of their Diameter, and in their Structure and Situation. All these little Arteries and Veins are uniform, extremely narrow, and though their Sides are not thinner than those of the valvular Lymphatics, yet their Diameters are generally less. The other Lymphatics are full of Valves, and very thin, but they are not narrow in Proportion. The arterial and venal Lymphatics are found on the Parts which are naturally white, as on the Skin, the White of the Eye, &c. and their Origins are easily discoverable; but the valvular

Of the Secretions.

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vular Lymphatics are confined to the internal Parts of the Body, and are found on Parts of all Colours that are in the Body, and we cannot easily trace them to their original Sources*.

The Classes or Tribes of Humours, which, being deposited or strained off from the Blood into other Vessels, are said to be secreted or secreted, seem reducible to four; of which the first includes all the viscid and lymphatic Juices, which, by Fire or Alcohol Vini, turn into a hard Coagulum, although generally in the living Animal, they are capable of flying off in Form of a Vapour, and after Death are within the same Vessels compacted into a gelatinous Thickness. To this Class belong the vapourous Juices of the Ventricles of the Brain, of the Pericardium, Pleura, Peritonæum, vaginal Tunic of the Testicle, of the Amnios, Joints, and probably of the Womb, with the Juice of the Stomach and Intestines, of the renal Capsules, and lastly the Lymph itself commonly known and called by that Name.

The second Class is of those Juices, which are some of them exhalable like the former, but being more simple and aqueous, are neither to be coagulated by Fire, nor by rectified Spirits of Wine; and others of which do not exhale, but being deposited in their respective excretory Ducts, are expelled by some common Outlet, proper to a Part of

* I think it very proper that the ancient Division of Glands into conglobate and conglomerate should be retained. Under the first Kind I include the lymphatic Glands alone, and all the other Glands of the Body under the second; and these again may be subdivided into simple and compound. I must be obliged to refer what still remains to be said concerning the internal Structure of Glands and glandular Bodies to a particular Dissertation, which is designed to contain an Answer to HELVETIUS's Letter published at the End of his late Performance concerning the Pulmonary Blood. WINSLOW.

some Gland. To the former of this Class belong the perspirable Matter of SANCTORIUS, and probably the internal perspirable Matter of the Epithelium and cellular Substance, with Part of the Tears and watery Humours of the Eye. To the latter of this Class belong the remaining Part of the Tears, the Saliva and pancreatic Juice, that of the renal Capsules, and the Urine. The Sweat seems to be a Mixture of the perspirable Matter, and subcutaneous Oil.

The third Class differing from both the preceding, includes the viscid sluggish or filamentous Juices; but such as are of a watery Disposition and not congealable into a Jelly, but hardening into a Crust-like, or scaly Substance, by exhaling their Water. Of this Sort are all the Kinds of Mucus in the human Body, spread through all the internal Passages for Air, Aliments, or Urine, the Cavities of the genital Parts, Liquor of the Prostates and Semen, to which add the black Humour of the Uvea in the Eye.

The fourth and last Class is that of the inflammable Juices, which, at their first Formation, are indeed thin and watery, but, by Time, stagnating and exhaling their more watery Parts, become a thick, oily, inflammable Liniment often very bitter. To this Class, we refer the Bile, Ear-wax, sebaceous and oily Liniment of the Skin, the Marrow, and all the Fat of whatever Consistence or in whatever Part seated throughout the human Body and the Milk itself, so far as it is butyraceous and inflammable.

Those who consider, that in the Blood are found a coagulating Serum, an exhaling Water, a Sort of viscid Mucus, and lastly, a thick and thin Oil, may thence begin to perceive the Possibility of a
Separation

Separation to be made from the Blood of all the foregoing Classes of Humours; in as much as we thus see their constituent Principles are already in the Mass of Blood itself. But in what Manner it is brought about, that Oil is separated from the Blood in one Part, an aqueous Liquor in another, or a gummy Mucus in a third, is a Task that still remains to be explained, and requires a previous Knowledge of the secretory Organs themselves.

The albuminous or hardening Juices are separated almost every where from the Arteries themselves, into continuous excretory Canals, without any intermediate Organ or Machine betwixt them. The Proof of this we have from Injections of Fish-glue, Water, and thin Oils, which very readily pass the red Arteries, and are poured out like unto Sweat into all the Cavities of the Body, in which we naturally find the said serous Vapours in Form of a coagulable Water, nor do the Injections in this Course meet with any intermediate Obstructions from any hollow Cavities and Cells. Finally, the Blood itself, being so readily poured out into most of these Cavities, without any permanent Damage, when its Course is either much obstructed, retarded, or urged with a greater Impetus through the Arteries, shows plainly that there is a short and open Way betwixt the red Blood Vessels and those excretory Ducts; (whence the yellow Serum differs not much from the Cruor.)

Among these Juices we reckon the venal Lymph, mentioned before, which passes through the valvular pellucid Vessels to the thoracic Duct. For this seems to be drawn off immediately from the Arteries, if we give any Credit to the numerous Experiments of great Anatomists, which show that the red Blood, Mercury, and other Liquors pass

from the sanguineous Arteries directly into the valvular lymphatic Veins themselves. The Credit, both of this Fact and the Experiments, is also further confirmed by the Mixture of Redness and Yellowness, often observable in the Lymph itself; and which, by the Microscope, is a Demonstration of the red sanguineous, and yellow serous Globules, which pass and float in the Lymph.

It must not indeed be denied, that these lymphatic Vessels have a sort of peculiar Glands to themselves, into which the said Lymphatics deposit their contained Juice, and then convey it away from it again. But then the lymphatic Vessels do not arise in these Glands, with which they only communicate in their Passage. For, they arise visibly enough upon the Surface of the Lungs, Liver, and Intestines, and run on for a considerable Length before they enter those Glands.

These Glands then seem to contribute something peculiar to the Lymph and Chyle in their Course, more than has hitherto been well discovered. The Structure of them here follows. They appear, as they are called, conglobate, or of an oblong, Olive-like Figure, sometimes solitary, but often in Clusters, and loosely invested in the cellular Substance, in which they enjoy a Sort of free Liberty, or floating Motion, in most of the internal Parts of the human Body, and in many of the external Parts. Among the latter we may reckon those which, arising in the Face and superior Part of the parotid Gland, and Angle of the inferior Maxilla, descend along the Side of the Neck with the jugular Vein; thence dividing as it were, or receiving a Collection of Glands from the Arm, they pass on in a direct Course with the subclavian Vein to the Arm-pit, where they are most numerous. Some again are extended as far as the Flexure of the
Cubitus

Cubitus itself; but none appear on the rest of the superior Extremities, nor upon all the Back.

In the Thorax they descend in great Numbers with the Trachea Arteria, and along the Sides of the Pericardium, others descend anteriorly upon the Vena Cava and Pericardium down to the Diaphragm. The Posterior Lymphatics are many, encompassing the Trachea Arteria on all Sides, and playing round its Ramifications, reach to the Extremities of the Lungs, while those in the Posterior Mediastinum ride over the Pericardium, and with the thoracic Duct extend to the Diaphragm.

In the Abdomen lastly, there are others called the lumbal Lymphatics, which form a considerable Collection in the folding of the Groin, whence extending along with the great Blood Vessels in the Course of the sartorius Muscles, they vanish in the Ham or bending of the Knee. Other Lymphatics pass from this inguinal Collection into the Pelvis, and continue their Course upwards through the cellular Substance, behind the Rectum, and along with the large hypogastric Vessels. There are also small lymphatic Glands of the same Kind, with their respective Assemblages, seated in the greater and lesser Curvature of the Stomach, and the Origin of the great and little Omentum, at the Entrance of the Porta into the Liver, in the Course of the splenic Blood Vessels near the Spleen, and lastly, thro' the whole Extent of the Mesentery and Meso-colon.

The common Fabric of these lymphatic Glands is, that they consist of strong, external, smooth Membranes, furnished with many red Blood Vessels; within which is a soft and lax cellular Substance, but of a short Extent, betwixt the Cells of which run numberless small sanguineous and lymphatic Vessels,

fels. As for any Folliculus, or Concavities, muscular Fibres, or duplicate Membranes, they are to me unknown.

That these Glandules are of some Use to the Lymph and lymphatic Vessels, is certain enough, because we see no lacteal or lymphatic Vessel ever reaches to its Insertion, without first distributing its Branches thro' one of these Glands, and receiving reductory Branches thence. The chylous Juice with which these Glandules are filled in Children and other young Animals, and the Ink-like Juice which they contain in the Breasts of old People prove that there is something separated from the Blood in these Glands, and poured into the Lymph and Chyle, which are here probably expelled into the cellular Spaces of the Gland. Their greater Magnitude and more perfect Structure in the younger Animals, with the shrinking and Corruption or Destruction of them in Adults, and old People, persuade us, that this their Secretion is more perfectly made in the younger Animals, and that it perishes in the older. And no Part is oftener scirrhus than these; whence it is not probable, that the Lymph is in them accelerated. The Thymus is of the conglobate Kind of these Glandules, but divided into Lobules; there are found also in the Groins, Arm-pits, and other Parts, conglobate Glandules of this Sort, collected into Clusters.

Another coagulating Juice, which hardens likewise by mineral Acids and Alcohol, is the albuminous Humour of the Joints, which, mixed with some Fat and medullary Oil, makes a most soft or smooth Liniment, to lubricate the Heads of the Bones and lessen the Friction of the Articulations. For the Separation of this Liniment, certain conglomerate Glandules of a peculiar Fabric are assigned, which

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are usually so placed in the rough Sinuosities of the Joints, that they suffer a moderate Compression, increasing their Discharge, without bruising by the Motion.

These mucilaginous Glandules have a peculiar Fabric. The larger of them rest upon the Bones with a broad Basis, from whence they are gradually extenuated or acuminate into a Ridge, from the thinnest Margin in which they deposit their Juice by open Ducts. They have a good deal of Fat intermixed, and are manifestly composed of lesser Bunches. Others still smaller are scattered about the vaginal Capsules of the Tendons, and betwixt the dividing Fibres of the Tendons, which last seem to be almost of the Nature of simple Glandules, turgid with a yellow mucous Secretion.

The uncoagulable Juices of the first Sort are secreted in the same Manner with those which harden, to wit, from the exhaling Arteries, which arise from the red sanguineous Arteries, without any intermediate Follicle or Cavity betwixt them. Thus the Vessels, which pour out the perspirable Matter through the Skin and lacrymal Ducts of the first Sorts suffer a watery thin gluey Injection to transude so readily from the Arteries, as leaves no Room to doubt of this Truth. (And these secretory Ducts have also a considerable Degree of Irritability; whence by any Stimulus or Contact of acrid Particles, they discharge more Juice in a given Time, than what they distil in a State of Health.)

But in the latter salival Kind, of that Class, the Secretion is made by Means of conglomerate Glandules, which the Ancients so called from their Cluster-like Fabric, and esteemed them almost the only proper Glands. These are composed of roundish Lobules or Clusters (somewhat like those in Bunches of Grapes, Currants, Barberries, &c.)

loosely

loosely conjoined together into large Masses by the yielding cellular Substance, which, at last, often forms a denser Tunic or Covering to the whole, like as we see in the parotid and maxillary Glandules. Through the Interval, betwixt these glandular Clusters run the Arteries and Veins, which are here large or considerable enough, but most of the conglomerate Glandules separate their Juices in such a Manner, from the Blood, and from thence discharge it so, that each clustery Portion sends out an excretory Duct, which, joining with the others of the same Kind, form larger Trunks, which at last, in the Manner of a Vein, end in one Canal, which conveys the Humour separated by the Gland, to the Part for which it is designed, as the Cavity of the Mouth, Intestines, Surface of the Eyes, &c. There are indeed, some of these Glands in which the said excretory Ducts are either not present, or at least, not yet discovered; as we observe in the thyroid Glandules, those called Capsulæ Renales, the Thymus, and the pituitary Glandules.

The Acini or Kernels of these conglomerate Glands are each of them circumscribed and limited by a harder Stratum of the cellular Substance; by which Substance they are also subdivided into lesser Acinuli, as is evident to the Eye and by the Microscope. But it may be questioned, how does this Subdivision end, whether or no is every simple Acinus hollow in the Middle, that, by receiving the Humour transuding from the Arteries into the Follicle or Cell it may be sent out thence by the excretory Duct; whether or no we are persuaded to believe such a Fabric obtains from the small Shot-like Stones and Hydatides bred in these Glands, with the round Scirrhi that sometimes fill the Kidneys? whether in this Opinion made probable

bable by the morbid round Concretions formed in the Liver, Spleen, Kidneys, Testicles, and Cortex of the Brain? or from the Bunch-like Division or Appearance, which those Viscera have in younger Animals? whether the cellular Substance that surrounds the extreme Vascules in all Parts, does not communicate by open Areolæ, or Cells, in a secreted Humour is poured by these Glandules? In short none of these Arguments appear true or conclusive. For the Acini, which are found in the Viscera of Animals, are component Lobules and not elementary Parts, but are large and compounded for the Conveniency of each Beast. The morbid Concretions are almost all of them a Sort of Placentulæ, and take up their Seat even in the Limbs themselves where there is not the least Room to suspect any Thing of the glandular Fabric, and are composed, as to their Matter, of Oil, Earth, and vapourous Particles, extravasated into some of the Intestines of the cellular Substance, where, stagnating and compressing the adjacent Follicles, they form to themselves proper membranous Tunics. On the contrary, the watery and fluid Nature of the Juice secreted in these Glands, are Arguments that it meets with no Obstruction in the Separation, nor Places of Stagnation in its Way. For all the Juices, which rest any Time in the warm Cavities of the human Body, which are full of absorbing Vessels, are each of them more or less inspissated, and approach either towards a Mucus or an oleaginous Disposition. Moreover, if there were any such Arrestments, anatomical Injections would meet with more Difficulty in passing from the Arteries into the excretory Ducts of those Glands; which, under such Circumstances, would be impervious to thick Injections, and thin ones they would exhale into their cellular Fabric.

Yet

Yet we see that the superlative Art of great Anatomists has not only conveyed Injections, but even thick ones like Wax, directly from the Arteries of the salival Glands, Liver, &c. into their excretory Ducts, and this without filling up any intermediate Knot-like Cavities, which, according to the foregoing Hypothesis, they ought to exhibit.

Therefore the Acini of these Glandules appear composed merely of Arteries and Veins (which last include excretory Ducts) divided and subdivided, parted and connected by the Intervention of a good deal of cellular Substance, whose Strata, growing gradually more compact or firm as they enlarge, at length shew their Contents moulding into a sort of globular Nut-like Figure. In the Belief of this, we are confirm'd by Analogy, in the Lobes of the Lungs, the Lobules of the Thymus, and from the Structure of Insects, but more especially the Fabric of the Testicle, in which we plainly see that Lobules are formed of excretory Ducts, connected in Fasciculi by a very soft cellular Membrane. But they seem not to pour their Juices into a cellular Fabric, which would intercept or make difficult, the Passage to an excretory Duct.

Thin watery Juices, neither coagulating nor wholly evaporating, are likewise in other Parts generated without the Assistance of conglomerate or kernelly Glandules. For thus the Urine is deposited from the red and sanguineous Arteries into membranous Parts, with which they are manifestly continuous and form an easy Way, admitting Air, Water, and Mercury to pass in like Manner. And after the same Manner, tho' less evidently, the nervous Juice seems to be separated in the Brain.

The third Class of mucous Juices are indeed almost every where separated into, and discharged from
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the Sinus of hollow Glands. These true Glands or Follicles have, in general, such a Fabric as makes up an ample Cavity, every Way circumscribed by a Membrane; but in such a Manner, that the Flesh itself of the Part, to which the Gland adheres, is often taken for another close Hemisphere of the Follicle. The said Cavity or Follicle is for the Generality round, but sometimes it is oblong, and obliquely creeping betwixt the adjacent Parts, as for Example in the Urethra of the Male, and in the Follicles of the Female Sinus.

Into these Follicles or Cells, the least Arteries (or the vascular Flesh surrounding each Crypta or Cell, and compleating its Convexity) open by produced Extremities within the Cavity of each Crypta, into which they distil or exhale their respective Juice, where, being retained from the Narrowness of the excretory Ducts, the more watery Parts are drawn up by the absorbing Veins, which correspond to, and resemble the exhaling Arteries, and thus the follicular or cryptal Juices receive a considerable Degree of Thickness. The Truth of this we are taught from the Structure of the simple Follicles, observable in the Tongue, in which both the importing arterial Ducts or Pores, and likewise the excretory Orifice, are visible to the Eye; and from the Vessel-like Tubuli lining the Stomach of Birds, Quadrupedes; and Mankind in each of which an importing small Artery, a reductory Vein, and an excretory Canal, appears to open pendulous in the Cavity; and lastly, from Injections, which discharge a colourless Wax into the simple Glands.

Whether the mucous Cavity of such a Glandule be long or round, it has always an excretory Duct, which, for the most part, is none of the least; altho' in the round mucous Glandules, the discharging Duct or Orifice be less, in Respect to the
reserving

reserving Cavity, than in others. This discharging Orifice often opens into the common large Cavity, into which the Mucus is to be poured, without any intermediate Duct, for thus it is in the Back of the Tongue, and in the simple Glands of the Stomach and Intestines, where they have been demonstrated Cryptæ or Cells by RUYSEN. The Sinuses have often the like Fabric, opening without an intervening Duct, as in the Urethra of the Male.

Another Kind of these mucous Glandules are those which we commonly call conglutinated; where many simple Follicles are folded up together in one common Covering, and open with their gaping Orifices into one common Sinus, without forming any true excretory Duct. This Fabric we observé in the Tonsils.

Other simple Glands of this Class have an excretory Duct, by which they expel their Mucus, namely, a narrow, membranous, cylindric, small Vessel, opening with its posterior Orifice into the Cavity of the Glandule, and with its anterior Orifice into the common Cavity, for which its Mucus is designed. These excretory Ducts are of considerable Length in the subcutaneous and sebaceous Glands, and in those of the Palate and Wind-pipe. In some Parts also, the Pore or Orifice, and its Duct, are more easily demonstrable, than the Follicle or Body of the Gland itself as in the Nostrils, Larynx, Rectum, &c.

In others again, an Assemblage of these Ducts, arising each from its respective Follicle, run together into one like the Branches of a Vein, so as to form a considerable excretory Canal, common to a Number of Follicles. To this Kind belong the compound mucous Glands of the Intestines, some of the larger in the Cavity of the Urethra, with the blind or impervious Duct or Sinus at the

Root of the Tongue, to which, in Brutes and Birds, add the Fringe-like Tubuli of the Stomach. The Glands of this Sort may be called simple ones compounded or continuous; but where they lie only contiguous one to another, they may be called simple aggregate or congregated Glandules; as are those of the Fauces, Stomach, Intestines, &c.

The inflammable Juices are separated by Organs differing in their Fabric. The Fat and Marrow are deposited without the Intervention of Glands, from the small Mouths of the least Arteries into the cellular Coats or rather Substance; and the same Fat again escapes from under the Skin by small Pores or Ducts, without the Assistance of any glandular Follicles. But the Ear-wax, and the waxen or sweaty Liniment of the Skin, are separated by Glands of divers Kinds. Most of the sebaceous Glandules are visible enough, with an open or naked Mouth in the Skin, that leads immediately into the Follicle, without any Duct of considerable Length, as we see in the external Ear, Nose, Rings about the Nipples, in the female Nymphæ, and the Valley or Grove that runs betwixt them and the external Labia, in the Clitoris and male Glans Prepuce. These differ but little from the Crypta, except in their contained Matter, which they separate.

There are others of the sebaceous Glands, which have an excretory Duct of a considerable Length, like most of those in the Skin, which, being seated in the cellular Substance, have consequently a Duct long enough to perforate the Skin. Thus we see, it is in the Face more evidently, where the Length of the Duct is often to be measured by the concremented Maggot-like Substance pressed out, that a Follicle or Cell lies under the narrower Pore.

There are still other sebaceous Glands of the continuous or conglomerate Kind, in which many Cryptæ by small Ducts meet together in one larger excretory Duct. Thus in the Face, in several Places, where there are large Pores in common to a Number of subjacent Cryptæ. And of this Kind are those sebaceous Sinks in the Eyelids ; and thus it is in the Organ which separates the sebaceous Perfume, in the sebaceous Glandules of the Musk-goat of *America*.

The Milk being a Humour of its own particular Kind, formed of Oil and watery Juices intermixed, is separated by conglomerate Glandules. Whether the Secretion of the Bile be glandular, is controverted ; but there are many Arguments to persuade us, that the Liver is a mere vascular Fabric, whence the Bile distils immediately from the Extremities of the Porta into the Pori Biliarii or Origins of the biliary Ducts, without passing any Cells or Follicles by the Way ; and in this we are more especially confirmed by the Ruyschian Art of Injection, in which the Wax passes directly from the Porta into the biliary Ducts, without exhibiting any intermediate Stoppages ; and therefore we see the Milk and Bile are both of them much thinner and more watery than the Fat, or the sebaceous Matter which thickens in Follicles.

It now remains for us to inquire, how from one common Mass of the Blood, the same Variety of peculiar Juices are constantly separated each in their respective Places, so that we never see Milk secreted in the Kidneys, Bile in the Thymus, or Mucus in the sebaceous Glands. This Problem, indeed may be solved by one, who shall have previously acquired a thorough Knowledge of the intrinsic Fabric, that obtains in each secretory Organ. In the mean Time, we shall here propose,
what

what has been hitherto advanced with Certainty on that Subject from any known Principles, whose Truth we are convinced of.

And first, the Blood itself, from whence the Humour is to be secreted, undergoes a Sort of hydraulic Preparation in the various Parts, by which it puts on such a Character or Disposition, there peculiar to itself, that more Particles of a like Nature with the Humour abound in that Blood, which Nature intends to separate from it. In the Liver, the venal Blood, with a very slow Motion, full of Oil, and full of the semiputrid Vapours of the Intestines. At the Testicles, the Blood is brought slowly through very long, slender, and inflected Canals, arising at very small Angles, and passing out at the Abdomen through a cold Tract under the Skin. In the Carotids, it is probable that the denser Parts of the Blood ascend, while whatever is more watery descends into the Abdomen and to the Kidneys: Also to the forming of the salival Juice of the Pancreas, Liquors of the Stomach, and Intestines.

Another Preparation of the Blood towards Secretion, is from its Retardation in the least Vessels whereby the red and denser Parts of the Blood go on by themselves along the Axis of the Canal, while the other lighter and more sluggish or viscid and less moving Particles, recede to the lateral Opening or Branches, so as to enter the secretory Orifices, which pass out from the Sides of the said Vessels.

The Passages of these secretory Orifices, tho' of different Diameters, are yet always small enough, in their healthy and natural State, to refuse the red Blood. Hence, therefore, we may conclude, that, being enlarged by an increased Force of the Heart, they every where admit of a good deal of

the red Blood from the sanguineous Arteries, which they arise from, and open into; being in their natural State not much less than the red Globules. And hence the same secretory Orifices or Ducts, which refuse thick Injections of Wax or Suet do, nevertheless, generally admit thinner Liquor injected into the Arteries. Therefore this is the first and most simple Mechanism, or Machine of Secretion, viz. that the Opening of the excretory Duct may admit only such Particles as have their great Diameter less than the Diameter of the said Opening. From this Reason only, it is, that the yellow Arteries convey off a pure Liquor from the Blood, and that the uniferous Ducts exclude both the red Blood and coagulable Serum. But this is not the sole Cause, since the same Juices are generated by large as by small Animals.

Merely by this Law, (of this secreting Orifice) the secreted Juices may be of many different Sorts: for those, whose Lights or transverse Sections are the least, will receive only the thinnest Juices, as in the small Vessels of the Brain; and the larger Ducts will admit Water and Jelly, while the thickest Fat will enter the largest of all. Moreover, if a Number of secretory Organs are formed in a Succession from one secreting Artery, each of them having large Mouths or Ducts, in that Case, the least, which comes out from the said Artery, will receive only the thinnest Juices. But if these, which are first formed in Order from the secreting Artery, have smaller Ducts, than the last only will receive the grossest Juices.

From hence it is, that the Secretions, which are generally made immediately from sanguineous Arteries, without passing the several lateral ones, are all of gross Juices, thick, coagulable, or watery, as the Fat, Urine, Juice of the Stomach and Intestines,

testines, &c. But the other thinner Juices are secreted not from sanguineous, but from smaller pellucid Arteries arising from the former. To the discerning Mouth, therefore, of these last not only no red Blood, but no Serum, Fat, or other gross Juices, can have Admittance. Thus the more thin and pure Humours are separated of consequence; as for Example, in the Eyes, Cortex of the Brain, &c.

Some Share of the Secretion ought, perhaps, to be allowed to the Angle, which the secretory Branch intercepts with its Trunk. For it is easily demonstrated, that at right and retrograde Angles, only the viscid, and sluggish Juices are expelled by the stronger Force of the denser Particles which hold on their Course along the Middle of the Artery; whilst the Denser go off at half right Angles. For those who have made the truest Observations on living Animals, have seen, that the Velocity of the Blood is greatest in Vessels of the acute Angles, and less in those of right Angles. That the Effect of these Angles in the Vessels is considerable, with regard to the Secretion, we are persuaded from the Structure in several Parts of the Body, since they form different Angles in different Parts, with Respect to their Trunks; and in some Parts compose Net-work. For the small Vessels in general resemble the Branchings of little Trees or Shrubs, the Trunks and Arms of them every way sending out smaller Branches, but in different Angles, at small Angles, for Instance, the large Intestines, and at larger Angles in the smaller Intestines. Thus in the Spleen, the small red Arteries arise thick from their Trunks, that they resemble a Wisk or Sprinkler; in the Intestines, they resemble Pencil Brushes, vermicular Arches in the Kidneys, Stars in the Liver, and a radiated Circle in
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the Uvea, and in the Testicle, a Lock of Hair curled up into a Button. But we deservedly receive it as a Rule, that the Creator never made this Diversity of Fabric without its proper Use and Effects.

And the Inflexions of the smaller Vessels greatly retard the Motion of the Blood, in which, therefore, the greater Part of the Force received from the Heart, is evidently spent in changing the Figure of the Vessels. The repeated Inflexions, therefore, of the secretory Arteries increase the Viscidity of the Juice by delaying the Flux, and giving the Parts more Time to cohere or attract each other. But a strait Course of the Vessels increases the Celerity of their Fluid, whence a copious and easy Secretion more uniform or impure, as we see in the Urine.

That the smaller Arteries have different Degrees of Density or Firmness, there is no Reason to doubt; since we actually find it so by Experiments in the larger Branches. But the denser the capillary Arteries, the more they resist the light and slowly moving Particles, and yield only to the more dense ones, that have a greater Impetus.

And, lastly the Velocity is greatly increased, when the excretory Duct arises a good deal before the Extremity of a larger arterial Branch that ends with a short Course; and is equally diminished, when the small secretory Artery runs a long way capillary and cylindrical, whereby the Blood loses the greater Part of its Motion in Friction. Finally, from whatever Cause the Diversity of the Blood's Motion may arise, a greater Velocity of it causes the secreted Juices to be more dense or heavy, more gross and un-uniform or impure; but Slowness of its Motion increases the Attraction and Viscidity, and probably renders the secreted Juice more pure and homogeneous, as the similar Particles,

ticles, thus sorted and brought together, can better attract and join each other under a slow Motion, so as to retain the larger Canal while the thinner Parts go off by the lesser lateral Branches. From hence it is, that only the Impulse of the Heart being too much increased, all the Secretions are confused.

From all that has been hitherto advanced, we may now begin to perceive, that, since the Blood contains Particles, of various Kinds, some sluggish or filamentary, others mucous, others coagulable; some again very fluid, others more dense and red, some glutinous, some watery and thin, others fat and gross: Among all these Particles, those which are the largest and most dense, as the red and yellow Globules will go on most towards the Axis of the Vessel, so as to pass on in a continued Course from the Artery into the Trunk of the sanguineous Vein.

Those Particles, which are ramous, gross, and sluggish, as the Fat, must needs go off laterally by larger Orifices from the sanguineous Artery, by short Ducts; for long ones would make a Stop to so sluggish a Juice as the Fat or Oil. Therefore we see, that the Circumstances or Rhœnomena of the Adipose Secretion, agree with this Description. Such Parts as are coagulable, but specifically heavier than those which are merely watery kept fluid only while the Powers of Life are in Action; these pass off laterally from the sanguineous, into the pellucid Arteries less than the red Arteries, with which they are continuous; whether these pellucid ones are continued on in the Nature of Trunks, sending off other smaller Branches like the least Arteries; or whether they exhale their Contents by a short Extremity.

Thin watery Juices may evidently pass off by any Vessels continuous with the sanguineous ones or the lesser ones provided they be only small enough to refuse the grosser Juices : And this, whether they come out from the Sides of the larger Arteries, or whether by a long continued Course ; and sending off all the grosser Juices by large lateral Branches, they at length, end in a smaller pellucid Canal instead of a Trunk, like that which supplies the clear Contents of the Eye. To the Production of the Juices, the more simple Fabric is sufficient : Even a direct Continuation of the secretory Artery itself into an excretory Duct, as we see in the Urine. Therefore the Ducts and Vessels have here a strait and simple Course, with few or no Inflections, and a proportionable Velocity or Celerity, as yet holds in the Course of their contained Juices.

Such Juices, as being watery, light, mucous, and viscid at the same Time, are consequently sluggish and less moveable ; these may be easily secreted by short narrow Ducts of a less Diameter than to admit the Fat, and appended to the sanguineous Arteries ; and therefore, it is evident, these will be separated from the Blood more abundantly in some Parts of the Body than others, namely where the Velocity, received from the Heart's Impulse, is less, the Flexures of the Artery more frequent, and where the Extent of the capillary shall be carried to a greater Length.

Whether or no ought we to ascribe to each particular Part the Ferments, Pores, specific Weights, or Filters, which determine the Nature of the Humour to be a generated one, who admits of these, ought to consider the great Difference there is in one and the same Juice, separated in the same Part of the Body, according to the Difference

ence of Age, Course of Life, &c. The Bile in a Foetus is generated sweet, the Semen thin and without Vermicules, the Milk either none, or very watery, the Urine watery, mucous, and insipid, the Uterine Mucus very white, the cutaneous Vessels full of red Juices, the lymphatic or watery Juices reddish, and the Fat gelatinous. By the same Organs, in an adult Person, the Bile separated is sharp or acrid, the Semen thick, the Milk sweet or oily, the Urine yellow, thin, and alkalescent, the Womb discharges a menstrual Blood, and lymphatic aqueous Humors, are most clear. But even in the adult Person, how different is the Urine; at one Time watery, at another thick or concocted, in a Fever high coloured and heavier, full of Salts and Oils. The Passions of the Mind, which make no other Change in the Body than that of Strictures in the Nerves, yet wonderfully change the Face of the Secretions, and expel even the Blood and Bile thro' the Vessels of the Skin. Add to this the frequent Disturbance of the Secretions, and Changes to which they are liable from slight Causes; so that only an increased Celerity shall cause several different Liquors to be secreted by one and the same Organ; for Serum and Blood have been known to pass into almost all the Passages of the secreted Juices, into those of the Sweat, Tears, Mucus of the Nostrils and of the Womb, and into the lactiferous, seminal, and urinary Ducts, as well as the Fat. A true Milk has been seen separated by Glands in the Thigh. When the Urine has been excreted by its natural Course through some Defect of the Kidneys, Ureters, or Bladder, it has passed by the Skin exhaled into the Ventricles of the Brain, or even into the whole cellular Fabric. The perspirable Matter of SANCTORIUS, however this is often by Cold drove through the

Nose or Kidneys, or by the same Cause, by Fear, or by Medicines, is deposited through the excretory Villi of the Intestines. That exhaling viscid Juice, secreted by the same Organ with the Fat, from which it so much differs, into the cellular Substance, is disposed, takes Place of the Fat, is absorbed and alternates again with the same, &c. A Salivation supplies the Place of the Sanctorian or cutaneous Exhalation externally, and of the cuticular Exhalation internally. The Bile reabsorbed appears evidently flowing in the Vessels of the Eyes, nor does there appear any Thing in the Fabric of any of the Viscera or Glandules that can fix or maintain the Nature of the secreted Fluid, but that a greater or less Velocity, or a Stricture of the Nerves, shall produce differently charged Juices in the intire Organs.

It now remains for us to discover, how the Secretions, in a healthy Person, become pure or uniform. For all the Juices, that have been lately secreted, (without excepting any, even the Oil or Fat itself,) have a great many watery Particles intermixed; so that none of the thicker watery ones, how then do the Semen, Bile, Fat, Mucus, and other thick Juices deposite their first watery State, and acquire their proper viscid and other Qualities?

For this End, therefore, Nature has framed Glands, with large and small Follicles or Reservoirs, for retaining the secreted Juices, from which the watery Parts are required to be separated, to render the remaining Part more oblong and viscid. The Mucus, at its first Deposition, is thin, and watery as yet, but little differing from the perspirable Vapours or Tears, in which State it distils into the Cavities of the Nostrils, Trachea Arteria, and Intestines. This is not continually discharging, because the excretory Duct, being sometimes long
and

and slender, so retards the Juice that it cannot pass out by the Assistance of a Pressure, or often, perhaps, not without a Sort of nervous Sphincter at its Orifice, be from the irritating Quantity or Acrimony of the Juice relaxed. This appears from the Morning Discharges of Mucus by blowing the Nose, coughing up from the Lungs, and by sneezing after the nocturnal Stagnation. In the mean Time the patulent Veins, extended into the Cavity of the Follicle, absorb the more aqueous Parts from the thin Mucus, that it may become thicker, as it is retained longer, but if by the Force of some Stimulus, it be directly discharged after it is secreted, it comes out thin and watery. Examples of this we have in the Urethra, in the Nostrils, and in the Ear-wax; as also the Bile, which, at its first Separation in the Liver, is watery, and has but little Yellowness or Bitterness. It is therefore, retained by a large Follicle or Gall-Bladder, and there digested or exalted by the vital Heat, and its more thin or watery Portion exhaled or absorbed by the Veins; whence the Remainder becomes more thick, bitter, and oily, or saponaceous. The same Mechanism takes Place in the Semen, which, being reserved in the seminal Vesicles, is there thickened, as to be very viscid after long Chastity; but in repeated Venery 'tis expelled very fluid. In some Places Nature has made this Receptacle two or three times folded together in one and the same Organ, when her Design was to form a very thick Juice. Thus the seminal Passage is in the Cell reticular, in the End of the Epididymus one large Canal, ending in a large Vesicle; whence the Vessels at the Testicle are narrow and so again are the Vas Deferens with the prostatic Duct.

Hence therefore, are never any Glandules placed in a Part, but for the Separation of a viscid Juice;

Juice; or if a viscid Liquor is any where separated from the Arteries, without a glandular or follicular Fabric intervening, it then always stagnates in some larger Vesicle or Cavity, of which we have Examples in the Seed, Bile, Synovia of the Joints, and in the Fat.

A secreted Juice may be likewise changed in its Receptacle by Irritation or the Affusion of some new Liquor. Thus the Semen thickens by an Affusion of the prostatic Liquor, the Chyle is thinned by Mixture of the salival and pancreatic Juice, and that which distils from the Villi of the Stomach and Intestines, and by an Affusion of the Bile it becomes alcalescent: And again the Synovia or Albumen of the Joints tempered by Fat and medullary Oil.

But the great Use of Follicles and Receptacles of Glands is to preserve the Juice, of whatever Kind it be, for those Tunics in which it is most necessary to be employed in the Actions of Life. Thus the Bile is reserved for the Time of Digestion, the Semen for due and lawful Venery, and the Mucus of the Nose is accumulated in the Night to temperate the Force of reflux Air in the Day.

Therefore as Nature has in this Way framed Machines, by which the Juices are retarded in the large and small Follicles, so she has made others to expel them at such convenient Times, to some Glands. She has given particular Muscles for this Use, as in the Testicles of Brutes, the urinary Bladder and the Gall-Bladder, or else she has placed other muscular Machines round them, which, by acting at convenient Times, expel the contained Fluids, as for Example, in the muscular Tunic of the Stomach and Intestines. In other Parts she has added contiguous and incumbent Muscles

to

to promote the Discharge, as in the Biventers and Muscles of the lower Maxilla, or else she has again joined to them a Kind of nervous Irritability, which, being excited to Action by an unavoidable Stimulus, opens the shut Passages to the Milk, Seed, Tears, &c.

The several particular Juices, which are derived from the Blood we shall describe more accurately, under their respective Organs, but before we descend to the particular Secretions, it was necessary for us to speak of Secretion in general, and especially of that universal one, which is made of nutritious Serum or Lymph thro' all Parts of the Body; thus we may next proceed to the Apposition or Accretion of it to supply the Deficiency of such Parts as are daily wasting in the human Body.

OBSERVATIONS.

The Formation of the Fœtus in Utero. The different Fluids being formed as the Animal increases, each different Fluid as it is generated, finds its Way thro' the Pores which are already formed, as in the Arteries through those which are on the Sides, and through the Glands, as they succeed each other in Generation; and this will be the same, whether the Gland of one protracted Tube or of Folliculi or Cryptæ.

Thus then these Glands, and these Pores, having once admitted such particular Fluids will no more suffer others of a different Nature to pass through, than the Paper dipt into Oil permits Water, or that in Water permits Oil to pass through its Pores.

In like Manner, in the Circulation of the Blood. As all these Particles are formed by the Action of 98 Degrees of Fire operating on that Fluid, whenever they pass by and come within the Sphere of
Attraction

Attraction of these Fluids already secreted, and continually secreting, they unite with them in the Pores like two or more Drops of Water into one; and thus the Glands continue to secrete the same Fluid as long as the Animal continues healthy, and to admit no other; and by this Method it seems to be that all the Secretions of the animal Body are performed and continued.

However, if, through Want of animal Heat, proper Diet, or Infection, the Nature of those Fluids is changed, then another, the next in Similitude, takes Place, as in Leuco-Phlegmatics, pethechial and miliary Fevers.

From this Account, some Reason may be assigned why some Men can never be made fat, that Fluid having never been secreted in the infant State to any great Degree, there have been no Pores in this Body accustomed to let it pass through them sufficient to make any Degree of Fatness; for this Reason in emaciated States, where the Fat is exhausted, and a limpid Humour of another Nature has passed through the Pores, where the Fat went before, it is extremely difficult to restore the Person to his former Plumpness; the greater Dissimilarity of the Fluids, the more difficult they take Place of each other.

Again, in Cases where the Bile is returned into the Blood, we see that it forces itself into all the lymphatic Arteries, as into those of the White of the Eye, and Urine not secreted, passes off thro' the Pores of the Skin, because those Fluids though sufficiently dissimilar to the native and natural ones, originally secreted in the Glands so as not readily to unite with them in the Circulation; yet, upon being forced back into the Blood in an over Proportion, they unite and go off along with others, as the Urine in Perspiration, and the Bile in the Urine.



A
C O U R S E
O F
Anatomical Lectures.
SPLANCHNOGRAPHY.

L E C T U R E I.
Of the PERITONÆUM and EPIPLOON.

AFTER the Abdominal Muscles are removed, we immediately meet with a Membrane named Peritonæum, adhering closely to the interior Surface of the Muscles of this Cavity, and investing all the Parts contained therein. The general Texture of this Membrane is pretty compact, and yet capable of considerable Expansion and Contraction, as we observe in Pregnancy, Dropsies, &c. and afterwards returning to its primitive State.

It seems to be composed, at least, of two Portions, one internal, the other external ; which have
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been looked upon, by many Anatomists, as a Duplicature of two distinct membranous Laminæ: But, properly speaking, the internal Portion alone deserves the Name of a membranous Lamina, as being the main Substance of the Peritonæum. The external Portion is no more than a kind of fibrous or follicular Apophysis of the internal; and may properly be termed the cellular Substance of the Peritonæum.

The internal Lamina is moistened by a serous Fluid continually discharged through the imperceptible Pores * of the exhaling Vessels.

The external Portion of the Peritonæum adheres very closely to the internal. It is not everywhere of an equal Thickness: In some Places there is a very small Quantity; and scarcely any appears at the tendinous or aponeurotic Portions of the transverse Muscles, and on the inferior Surface of the Diaphragm.

Elsewhere it is thicker, and forms Cells expanded into very fine Laminæ; which, in diseased Subjects, become sometimes so broad, and thick, as to resemble so many distinct Membranes.

In some Places this Substance is like a Membrana Adiposa, filled with Fat; as round the Kidneys, and along the internal Surface of the transverse Muscles, to which it adheres. It intirely surrounds some Parts; as the Bladder, Ureters, Kidneys, spermatic Vessels, &c. and it is, in these

* These Pores may be seen, by spreading a Portion of the Peritonæum on the End of the Finger, and then pulling it very tight on all Sides: For then the Pores are dilated, and small Drops may be observed to run from them, even without the Help of a Microscope.

The whitish Corpuscles, found in diseased Subjects, are no Proof of Glands, which some Anatomists place there in the natural State, as Dr. JAMES DOUGLAS imagined, in his Description of the Peritonæum.

Places, improperly termed the Duplicature of the Peritonæum.

Besides these Differences in Thickness, the cellular Substance has several Elongations, which have been called Productions of the Peritonæum. Two of these Productions accompany and invest the spermatic Vessels, in Males; and the vascular Vessels, commonly called the round Ligaments, in Females. There are two others, which pass under the Ligamentum * Fallopii with the crural Vessels, which they involve; and they are gradually lost in their Course downward.

To these four Productions of the cellular Substance of the Peritonæum, we may add a fifth, which is spread on the Neck of the Bladder; and, perhaps, a sixth, which accompanies the Intestinum Rectum. All these Elongations emerge out of the Cavity of the Abdomen, and may be termed external, to distinguish them from others that remain in the Abdomen, and are called internal.

The Aorta and Vena Cava are likewise involved in this cellular Substance of the Peritonæum: In a Word, it involves, immediately and separately, all the Parts and Organs which are commonly said to lie in the Duplicature of the Peritonæum.

The true Lamina, or membranous Portion of the Peritonæum, is connected, by the Intervention of the cellular Substance, to the inner Surface of the Cavity of the Abdomen; but it does not naturally accompany the external Elongations of that Substance. It only covers the Origin or Basis of these Productions, without any Alteration in its own Surface in these Places.

* There is no such Ligament, except you take the tendinous Extension of the Muscles of the Abdomen.

It has, nevertheless, Productions of its own ; but they are very different from those of the cellulous ; for they run, from without, inward ; that is, they advance from the convex Side of the great Bag of the Peritonæum into the Cavity of it, some more, some less ; and also different Ways ; just as if the Sides of a large Bladder were thrust inward into its Cavity.

Of these internal Elongations or Intropressions of the true Lamina of the Peritonæum, some are simply folded, like a Duplicature ; some are expanded like inverted Bags, or Sacculi, to contain some Viscus ; some begin by a simple Duplicature, and are afterwards expanded into a Cavity which contains some Organ ; some are alternately extended in the Form of simple Duplicatures, and of Cavities ; and, lastly, some form only a small Eminence on the inner Surface of the great Cavity of the Peritonæum.

Under the first Species of these Productions, we may reckon the membranous Ligaments of the Abdomen ; such as those of the Liver, Colon, &c. we see the second Species in the external Membrane of the Liver ; the third, in the Mesentery ; the fourth, in the Mesocolon ; and the fifth, at the Kidneys and Ureters.

Besides the external Productions of the cellular Substance of the Peritonæum, it has the same Number of internal Elongations with the true Lamina ; which lie between all the Duplicatures, and line the Insides of all the Cavities, or that Side next the Viscera contained in them.

The Uses of the Peritonæum, in general, seem to be very evident, from the Description which I have given of it : And the chief of these Uses are, to line the Cavity of the Abdomen ; to invest the Viscera, contained in that Cavity, as in a common Bag ;

Lect. I. and Epiploon. 5

Bag; to supply them with particular Tunics; to form Productions, Ligaments, Connections, Folds, Vaginæ, &c. as we shall describe hereafter.

The fine Fluid, which transudes through the whole internal Surface of the Peritonæum, prevents the Inconveniencies which might arise from the continual Frictions, and Motions, to which the Viscera of the Abdomen are exposed, either naturally, or by external Impulses.

It is to be observed, that the Peritonæum does not accompany the exterior Elongations of its cellular Portion: It covers the Base, or Beginning of these Elongations; and it is only in certain Hernias that it accompanies them, by slipping through the Aperture of the abdominal Muscles; otherwise, these preternatural Elongations of the Peritonæum are called Herniary Sacks; because they include, immediately, that Portion of the Intestine of the Epiploon which forms the Hernia. We say certain Hernias; for Experience evinces, that, in those named Exomphalos, there is no herniary Sack; nor in the Hernias formed in consequence of Wounds which penetrate into the Cavity of the Abdomen, &c. This ought to be carefully observed by Surgeons, in performing the Operation for these Hernias. VEDIER'S Anatomy.

Of the EPIPLOON or OMENTUM, and APPENDICES EPIPLOICÆ.

The Omentum is a large, thin, and fine Membrane, contained, on all Sides, by numerous Portions of Fat, which accompany, and even invest, the same; with a great Number of Arteries and Veins adhering closely to each other.

Its greatest Part resembles a Kind of flat Purse, or a Sportsman's empty Pouch; and is spread, more or less, on all the small Intestines,

from the Stomach to the inferior Part of the Regio Umbilicalis. Sometimes it goes down to the inferior Part of the Hypogastrium, and sometimes it does not reach beyond the Regio Epigastrica. It is commonly plaited, or folded, in several Places, especially between the Bands of Fat.

It is divided into a superior, and inferior; an anterior, and posterior; and a right and left Portion. The superior Portion is, in a Manner, divided into two Borders; one of which is fixed along the great Curvature, or convex Side of the Arch of the Colon; and the other along the great Curvature of the Stomach. The Commissure or Union of these two Borders, on the right Side, is fixed to the common Ligament, or Adhesion of the Duodenum and Colon, and to the contiguous Parts of these two Intestines. That on the left Side is fixed to the longitudinal Scissure of the Spleen, to the Extremity of the Pancreas, and to the convex Side of the great Extremity of the Stomach: It is likewise fixed to the membranous Ligament, which sustains the Ductus Cholidochus, and connects it to the Vena Portæ Ventralis.

Below these Adhesions, the other Portions, that is, the anterior, posterior, two lateral and inferior Portions, which last is the Bottom of the Sacculus Epiploicus, have commonly no fixed Connections, but lie loose between the Fore-side of the Cavity of the Abdomen and the Intestines.

The anterior and posterior Portions are generally called the Laminæ of the Omentum; but as that Term is ordinarily employed to express the Duplication of some compound Membrane, it would be more convenient to call them Folia, Alæ, or some such Name.

The Structure of the Omentum is, through its whole Extent, made up of two extremely thin Lamellæ, joined by a cellular Substance, the Quantity

tity of which is very considerable, along the Blood-Vessels, which it every-where accompanies, in broad Bands, proportioned to the Branches and Ramifications of these Vessels. These cellular Bands are more or less filled with Fat, according to the Corpulency of the Subject; and, for that Reason, I have called them Bands, or Portions, of Fat.

OMENTUM MINOR.

Besides this large membranous Bag, which I name the Major Omentum, there is another much smaller, which differs from the large one, not only in Size, but also in Figure, Situation, and Connection; and this is named the Little Omentum. This small Bag is fixed, by its whole Circumference, partly to the small Curvature of the Stomach, and partly to the concave Side of the Liver, before the Sinus of the Vena Porta, so as to surround and contain the prominent Portion of the Lobulus.

This Omentum is thinner, and more transparent, than the other; and its Cavity diminishes gradually from the Circumference to the Bottom, which, in some Subjects, terminates in several small Cavities, or Fossulæ, more or less pointed. Its Structure is pretty much the same with that of the Great Omentum; it being composed of two Laminae, with a Mixture of the same Portions of Fat, which are considerably finer than in the other.

We see, from this Situation of the two Omenta, that, in the Space left between the inferior Side of the Stomach and superior Side of the Mesocolon, they have a very broad Communication with each other; so that, if either of them contained in its Cavity any Fluid, that Fluid might readily get between the Stomach and Mesocolon, and so pass into the other Bag, especially when the Stomach

is empty ; and, consequently, its Situation is easily changed.

Therefore, by means of this Interstice between the Stomach and Mesocolon, the two Omenta form one Cavity, which opens into the Cavity of the Abdomen by one common Orifice, situated near the Commissure on the right Side of the Great Omentum. This Orifice is semilunar, or semi-circular, and formed by the Union of two membranous Ligaments ; whereof one connects the Beginning of the Duodenum, and Neck of the Vesicula Fellea, to the Liver ; the other connects the contiguous Portion of the Colon to the same Viscus, and extends to the Pancreas. From thence arises an incurvated Border, which surrounds the Root of the Lobulus, leaving an Opening wide enough to admit the End of the Finger.

To discover this Orifice of the Omentum, we need only raise, a little, the great Lobe of the Liver, and find out the Root of the Lobulus, and apply it to a large Pipe wrapped round with Cotton, Wool, or Tow, to hinder the Regress of the Air : Then, if we blow gradually, the Air will inflate the Sides of the Great Omentum, and give it the Appearance of a large Bladder, irregularly divided into several Lobes, or Tubercles, by the Bands of Fat, which appear, in this State, like so many Fræna between the Lobes.

This Experiment succeeds best, when the two Omenta are in their natural State, and handled very gently with the Fingers, first dipped in Oil. It succeeds better in young, lean Subjects, than in old or fat Subjects.

When we touch these Membranes with dry Fingers, they stick to them so closely, as hardly to be separated without being torn ; as we see by the reticular Apertures which appear in those Portions of the Membranes that have been thus handled.

In

In that Case, it is to no Purpose to blow through the natural Orifice already mentioned; and it is owing to these small Apertures, that the Membranes of the Omentum have been supposed to be naturally reticular.

The membranous Laminæ of the Little Omentum are continuous, partly with the external Membrane of the Liver, partly with that of the Stomach, and a little with the Membrane which lines the neighbouring Portion of the Diaphragm.

Those of the Great Omentum are continued partly with the same Coat of the Stomach, and partly with the external Covering of the Colon, and, consequently, with the Mesocolon; and they likewise communicate with the Covering of the Spleen.

We may satisfy ourselves, concerning these Continuations, by making a small Aperture in one of the Laminæ of the Omentum, near the Stomach, Colon, &c. and by blowing through a Pipe well fitted to it; for the Air will gradually insinuate itself under the common Tunics of these Viscera: But if the Parts be dry, they must be moistened a little before the Experiment is attempted.

APPENDICES EPIPLOICÆ.

The fat Appendices of the Colon and Rectum have always appeared, to me, to be a kind of small Omenta, or Appendices Epiploicæ. They are situated, at different Distances, along these Intestines, being particular Elongations of their common, or external Tunic. They are of the same Structure with the Great Omenta; and there is a cellular Substance, more or less filled with Fat, according to the Constitution of the Subject.

Next to the Intestine, each of them forms a broad thin Basis; and they terminate by irregular Pa-
pillæ

pillæ, thicker than their Bases. These Bases are, at first, disposed longitudinally; then obliquely; and, lastly, more or less transversely, especially near the Rectum, and upon that Intestine.

These Appendices are, for the most part, separated from each other; but some of these, which have longitudinal Bases, communicate together; the Vestiges of these Communications being very narrow, and not very prominent. By blowing through a small Aperture, made in one of these Appendices, it is inflated like a small irregular Bladder, and the Air passes under the external Coat of the Colon or Rectum.

Besides these Appendices Epiploicæ, we observe, at different Distances, along the Colon, between the ligamentary Band which lies hid, and one of the other two, that is, on both Sides of the Adhesion of the Mesocolon, several adipose Strata; which may likewise be looked upon as Appendices of the same Nature with the former; but these Strata are very seldom observed between the two apparent ligamentary Bands of the Colon.

As for the Uses of the Epiploon, it is not to be doubted, but the Fat, with which it is loaded, has the same Uses with that diffused through the whole Body; namely, to maintain the Flexibility of the fleshy Fibres of the adjacent Muscles: For Example, those of the Stomach, Colon, and Duodenum, to which it adheres; and, by entering the Mass of Blood, to assuage its Acrimony; and perhaps, according to the Opinion of some, to furnish the different Parts of the Body with Nourishment when they cannot have it elsewhere.

The Epiploon assists, also, in the Preparation of the Bile, by supplying the Blood, which is distributed to the Liver through the Vena Porta, with a certain Quantity of sulphureous Particles. And, lastly, it is to be observed, that the Epiploon, by
exactly

exactly filling the Vacuities left between the Stomach and Intestines, renders the Compression, which these different Organs must receive from the Muscles of the Abdomen, more gentle, and smooth; and, consequently, more advantageous, both for the Digestion of the Aliment, and the Distribution of the Chyle.

Vessels of the OMENTUM MAJOR.

The Arteries and Veins of the Great Omentum are Branches of the Gastricæ, and, for that Reason, go by the Name of Gastro-Epiploïcæ, Dextræ and Sinistræ.

The Arteries on the right Side answer to the Hepatic Artery; and those on the left, to the Splenic; and both communicate with the Arteria Ventriculi Coronaria, and respectively with the Arteriæ Mesentericæ.

The Gastro-Epiploïc Veins answer, in the same Manner of Distribution, to the Vena Porta.

Those of the OMENTUM MINOR come chiefly from the Coronariæ Ventriculi; and those of the Appendices and Strata are Ramifications from the reticular Texture of the Arteries and Veins of the Colon and Rectum.

OBSERVATIONS.

An uncommon Dropsy, from a steatomatous Omentum.

On opening the Body, it had the following Appearance; viz. the Belly hanging down over the Thighs, and monstrously swelled every-where, but with a Depression across the Belly, about the Midway between the Navel and the Sternum, the lower Part of which was advanced, and the Point of the Xiphoidæ Cartilage directed strait forward. The Hypochondria were also considerably raised; the
Thighs

Thighs and Legs were greatly œdematous, and the rest of the Body was much emaciated.

The cellular Tunic of the Abdomen was very thin, without containing any Water in it. In cutting through the Muscles and Peritonæum, on the left Side of the Navel, two Pounds of yellow Water ran out; and from the Cavity where this was lodged, ten Ounces of Pus were taken, with white tender Membranes swimming in it: Having cut the containing Part from the Navel to the left Loin, no more Water appeared; but eight Ounces of Pus were collected. All round the Cavity I observed a white hard Substance, composed of conjoined Vesicles, and adhering strongly to the Peritonæum: This I cut through into the Cavity; and, raising the containing Parts strongly, saw, behind them, a knotty Substance adhering to the Peritonæum, three Inches farther up, and then separating from the Peritonæum, it was extended backwards, and supported a considerable Quantity of Water, lodged above it. I next cut off, from the Peritonæum, that Substance, which, being extended from one Side of the Abdomen to the other, divided the Cavity into two: After this, I divided the containing Parts, and turned up the two Quarters of the Teguments, now raised, on the Ribs, to have a better View of the vesicular Substance adhering to their internal Surface. It consisted of a fat Membrane, beset with vesicular Bodies, either full of Mucus, or of a white, hard, steatomatous Substance. The epigastric Region was exceedingly enlarged; and out of the Cavity formed in it, I took thirty Pounds of Water, which had pressed out the surrounding Bones, and thrust the Diaphragm considerably upwards. I next dissected the Teguments from the vesicular Body, as far as it reached, which was to the Ossa Pubis, and there divided them.

All the Teguments being removed; below the Epigastrium appeared a large membranous Sac, of a brownish black Colour, distended with Air, and reaching from the Extremity of the Cartilages of one Side, to those of the other, when it sunk down under both Hypochondria: The middle Part of it was much the largest; no Division into Cells, or longitudinal Ligaments, were to be seen in it; though I found, afterwards, it was the great Arch of the Colon. The Part of the fat membranous Body left, when I cut this in raising the two superior Quarters of the Teguments, mounted over this Sac, and then, sinking backwards, adhered to another Viscus; and from the lower Part of this same Sac, depended a white vesicular fat Substance, with large Blood-Vessels spread on it. This, at first, was thin; but gradually, as it descended, became thicker, till it was hid by the anterior Lamella which had been dissected off from the Peritonæum. When this last was raised, I softly thrust my Hand into a large Bag, formed between the two, as far down as the Ossa Pubis, where they made one continued Substance. Besides these, I could observe no other Viscus except the Cæcum lodged in the Cavity of the right Ilia; wherefore I dissected the vesicular Body away from all the Parts it adhered to: All the Cells, cut in this Dissection, poured out Water. When this Body was wholly removed, I could not, at first, discover any Thing, in the Cavity below, except a flat circular Protuberance, lying on the Vertebra, covered with a dirty, black-coloured Membrane; and this, in a great many Places, had a white tender Membrane, resembling the Skin formed on boiled Milk, when it cools, lying upon it.

The Cavities of the Loins were very large, and filled with Water, as well as the Pelvis; and, under
the

the Water, Pus was every-where found: When these Liquors were taken out, the Surface of the Cavities had much the same Appearance with that of the larger middle Protuberance. The cellular Substance, furrounding the Pelvis, was two Inches thick, and distended with Water and Mucus.

I perceived a faint Resemblance of the small Intestines through the black Membrane, and discovered the Colon in the Loins. When the Membrane was taken off, all the Intestines came in View, of the Colour and Size usual in hydropic and emaciated Bodies; but the small Intestines, and Folds of the Mesentery, where they were contiguous, slightly adhered to each other by a weak sort of Membrane, which, when torn, yielded Water out of its Cells. The great Intestines were distended with Air, and in a natural Condition; the Mesentery was shorter than ordinary, but otherwise sound; the Stomach, hid in the great epigastric Cavity, was very little larger, in its transverse Diameter, than the small Intestines, but of a natural Colour: From its Fundus, the Remains of the cut Omentum depended, which was the vesicular Substance I at first divided in opening the Abdomen.

The Liver was hid under the false Ribs, and adhered so firmly to the livid Peritonæum, by its Membrane, which was about a Quarter of an Inch thick, that I could not observe its Colour, or Substance, till I had taken off the Membrane, when it looked pale, and had very little Blood in its Vessels. I found no Concretion in the Gall-Bladder; the Spleen was much in the same Condition with the Liver; the Pancreas was pale and hard; the Kidneys were in a natural Condition, but with little Blood in them; the Ureters were of the ordinary Size; the Bladder, Ovaria, Fallopian Tubes,

Tubes, and Uterus, were all found, only covered with a thick, livid Membrane: The Water and Pus weighed, in the Whole, forty Pounds.

The large vesicular Body consisted of two Lamellæ, which were thin above, but gradually turned thicker as they descended, till, at the lowest Part, where they united, they were six Inches thick: Each was covered, all over, with a smooth Membrane, only the anterior was ulcerated at its superior external Part. Several Ounces of purulent Matter, with Pellicles swimming in it, were taken out of the Cavity formed between the Laminae. When the external Membrane was separated, each seemed to consist of Vesicles of different Sizes, some of which were distended with Water, others with Mucus, and a third Sort with a steatomatous Matter.

From the Whole, this Body appears to be the Omentum diseased, which, probably, might be the Cause of the Dropsy, as well as Tumors of other Parts frequently are, of which I have seen several Examples. Is it peculiar to the membranous Parts, when suppurated, to have Pellicles mixed with the Pus? I have seen them in Inflammations of the Intestines and Pleura, as well as in the Omentum abovementioned.

Are these Pellicles, the Membranes, separated, and turned tender, by soaking; or the Particles of the Pus adhering and pressed firm? MONRO's Medical Essays, Vol. IV. Art. 30.

In Dropsies of the Abdomen, and in Persons who, from any other Cause, have died tabid, it is generally rotten, and decayed; and sometimes the Guts, in these Cases, adhere to one another: But whether these Adhesions proceed from the Omentum's ceasing to perform its Office, or from the peristaltic Motion of the Intestines being long dis-

con-

continued, through Abstinence, or both, I cannot determine. CHESELDEN's Anatomy.

On opening the Body of a Woman, who had been, for the Space of fifteen Years, troubled with a Dropsy, by which her Abdomen was distended to the Circumference of three Ells, and the abdominal Blood-Vessels were increased, in their Capacity and Thickness, beyond the Magnitude of the largest writing Quill. After a Number of Years, a Gangrene appeared above the Navel; by suppurating which, the Waters, contained in the Abdomen, burst forth with great Impetuosity; but we found the Omentum fleshy, and of the Thickness of a Finger, fastened to the Peritonæum, and including a Tumour as large as one's Fist; which being laid open, in Length, there first appeared a small Quantity of a white thick Matter, without any ill Smell; which being discharged, we found the rest of the Tumors to be nothing else but a Heap of Hairs, curled and twisted together in an intricate Manner. These Hairs were of different Lengths; some of them not being longer than one's Finger, and others were more than equal to a Span, in Length. These Hairs, being viewed through a Microscope, appeared, in every Respect, like those of the Head, excepting that they had no Roots. The Viscera had nothing uncommon. See RUYSCH's Observ.

A pregnant Woman, had, at the same Time, a Dropsy. She died some Time after she was delivered. Upon opening her Body, and discharging the aqueous Matter, I found the Peritonæum, in several Places, indurated with Particles which resembled Grains of Sand; and the Vena Porta was partly ossified: The other Viscera were pretty well, except the Omentum, which was intirely consumed. Ibid.

Other OBSERVATIONS on the Epiploon, &c.
from STEPH. BLANCHARD, Cent. 2. Obs. xlii.
in his own Words.

Quidam de doloribus in Abdomine ad Jugulum descendentibus à longo tempore quæstus; præsertim cum cibum fumeret. Is subito expiravit.

Omentum habebat putridum cui foetor aderat. Ingens erat Hepar, totumque fere Abdominis capacitatem implens. Lien exiguus. Hinc inde in Abdomine Vesiculæ flatibus distentæ. Exucci Pulmones lividi, & versus gulæ regionem inflammati. Cor solito majus.

Steatoma Omenti monstrorsum. Intestina juxta dextrum latus ascendebant, quibus remotis Tumor ingens propria Tunica, satis crassa, totam Abdominis capacitatem implebat, libras quinquaginta & sex adæquans: Adhærebat Ventriculi fundo, partibusque circumjacentibus. Continebat materiam adipi similem, partim Glandulosus fuit, partim quoque Scirrhus: Verum in medio cavitas foetida, fordidaque Sanie repleta fuit. Ibid. xxxvi Observatio.



LECTURE II.

Of the OESOPHAGUS and VENTRICULUS.

THE Duct which, from the Bottom of the Mouth, extends to the Anus, may be distinguished into three Parts. The Oesophagus is the Portion between the Bottom of the Mouth and the Diaphragm: The second, which is a kind of Sack, is called the Stomach: And the third, which reaches from the Stomach to the Anus, comprehends all the Intestines, commonly called the Bowels.

The superior Part of the Oesophagus is dilated almost like the Mouth of a Funnel; and this dilated Portion is called the Pharynx.

The Oesophagus descends along the Neck; being placed behind the Trachea Arteria; running, however, a little to the left, in Proportion as it approaches the Breast, where it enters; and, continuing along the Vertebrae of the Back, it crosses the fleshy Portion of the Diaphragm, which corresponds to it, and at last terminates in the Stomach.

The Oesophagus is composed of several Tunics, or Membranes, and of Vessels, both sanguiferous and lymphatic; with Nerves: We also find some small glandular Substances in it.

The first external Tunic is common to it with the adjacent Parts, and seems to be a Continuation

Lect. II. Of the Oesophagus, &c. 19

tion of the Membrane which lines the Cavity of the Thorax; and is called the Pleura: The second is fleshy, and composed of two Laminæ of Fibres, the exterior of which is longitudinal, and the interior circular.

This second is succeeded by a third, called the nervous Tunic, which appears to be formed of several tendinous Filaments, which cross each other in various Directions.

Lastly, The fourth, commonly called papilous, is very soft, porous, and always covered with a viscid Lymph, furnished by the glandular Granulations lodged behind it. In Conjunction with the nervous Tunic, it forms several Foldings, which run longitudinally along this Duct.

The Oesophagus is contracted and dilated by its Muscles.

There are great Numbers of Glands situated in the superior Part of the Pharynx; and excretory Osculæ, or Openings, are frequently discovered with them.

The Arteries of the Oesophagus are from the Carotids, the Aorta, the Intercostals, and the Cæliac.

The Veins run into the Jugulars, the Azygos, and the Coronary Vein of the Stomach.

The Nerves are from the Par Vagum. That there are also Lymphatics, is probable; but they are not easily discovered.

There are, also, certain excretory Ducts, called Ductus Excretorii Novæ Vercelloni*, which arise from the Glands, and convey a saltish Liquor into the Oesophagus and Stomach†.

* Vid. Dissert. Anat. de Gland. Oesophag.

† Probably, when these Ducts are any ways obstructed, it may cause an Angina; as I have sometimes found the Glands quite ulcerated.

The Glands from which these have their Origin, are of three Kinds; viz.

1. The Gastric Glands, which are conglomerate, are situated near the left Orifice of the Stomach.

2. The Dorsal ones, which are situated near the fifth Vertebra of the Thorax.

3. The Bronchial, Tracheal, and Thyroïde, already described.

The Use of the Oesophagus is for Deglutition, and a Commixtion of the Liquid serving for Digestion.

Of the VENTRICULUS, or STOMACH.

The Stomach is situated partly in the left Hypochondrium, and partly in the Epigastrium.

The Figure of the Stomach is like that of a Bag-pipe; that is, it is oblong, incurvated, large and capacious at one End, and small and contracted at the other. We see this Figure most evidently, when the Stomach is moderately filled with Air, or any other Fluid.

The Curvature of the Stomach gives us Occasion to distinguish two Arches in it; one large, which runs along the greatest Convexity; and one small, directly opposite to the former. I call these Arches the great and small Curvatures of the Stomach; and by the Sides of the Stomach, I mean the two lateral Portions which lie between the two Arches.

The Stomach has two Extremities, one large, and one small, like a crooked Funnel. It has two Openings, called the Orifices of the Stomach; one between the great Extremity and the small Curvature; the other at the End of the small or contracted Extremity. The first Opening is a Continuation of the Oesophagus; the other joins
the

the intestinal Canal, and is called by the Name of Pylorus.

The Stomach is not situated in the left Hypochondrium and Epigastric Region, in the Manner represented in most of the Figures; it lies transversely, obliquely, and almost laterally, in such a Manner, as that the great Extremity, and the Orifice next it, are on the left Hand; and the small Extremity, with its Orifice, or the Pylorus, on the right Hand; and lower, and more inclined, than the former: Therefore we ought, with the antient Anatomists, to call one of these Orifices superior, the other inferior.

The great Extremity of the Stomach is in the left Hypochondrium, and, for the most part, immediately under the Diaphragm: Yet the superior Orifice is not in the left Hypochondrium, but almost opposite to, and very near the Middle of the Bodies of the inferior dorsal Vertebra.

The small Extremity of the Stomach does not reach to the right Hypochondrium; it bends obliquely backward towards the superior Orifice, so that the Pylorus lies about two Fingers Breadth from the Body of the Vertebrae, immediately under the small Portion of the Liver, and, consequently, lower down, and more forward, than the other Orifice, by almost the same Distance. This Extremity of the Stomach has sometimes a particular Dilatation on the Side next the great Curvature.

According to this natural Situation, the Stomach, especially when full, lies so, as that the great Curvature is turned more forward than downward, and the small Curvature more backward than upward.

One of the lateral convex Sides is turned upwards, the other downwards; and not forwards and backwards, as they appear in dead Bodies,

where the Intestines do not support them, in their natural Situation.

If we divide the Stomach, along the two Curvatures, into two equal Parts, we shall see, that the two Orifices do not both adhere to the same Half of this Division, as we should be apt to imagine, according to the common Notion; but that the diaphragmatic Orifice is intirely in the superior Half, and the intestinal Orifice in the inferior.

Therefore the Body of the Stomach is so far from lying in the same Plane with the Oesophagus, as it is commonly represented in Figures drawn from a Stomach taken out of the Body, and laid upon a Table; that it forms an Angle, or Fold, immediately at the Passage of the Oesophagus, through the small Muscle of the Diaphragm: And it is on Account of this Angle, that the superior Orifice is turned backwards.

As to the Structure of the Stomach, it is composed of several Parts; the chief of which are, the different Strata which form its Substance, to which Anatomists give the Name of Tunicae, or Coats. These Tunics are commonly reckoned to be four in Number: The exterior, or common; the fleshy, or muscular; the nervous, or aponeurotic; and the villous, or interior Tunics. And they are afterwards subdivided several Ways.

The first, or exterior Tunic, is simply membranous; being one of the internal Productions of the Peritonæum. This appears evidently, at the Connection of the superior Orifice with the Diaphragm, where the external Membrane of the Stomach is really continuous with the Membrane which lines the inferior Surface of the Diaphragm; and it is from this that it has been named the common Tunic.

The second, or muscular Tunic, is made up of several Lamellæ of Fibres, which may all be reduced to two; one external, the other internal. The external Tunic is longitudinal, though in different Respects; following, nearly, the Direction of the Curvatures and Convexities of the Stomach; and the internal Lamina is transversely circular.

The Fibres of the external Lamina run slanting in several Places, and are intersected by small oblique whitish Lines, which seem to be, in some measure, tendinous. This Lamina is strengthened by a particular Fasciculus, which runs along the small Curvature; its Fibres appearing to be less oblique than those of the great Lamina.

The Fibres of the interior or circular Lamina of this muscular Tunic are stronger than those of the external. They are rather Segments which unite at different Distances, than intire Circles; and they are, likewise, intersected by great Numbers of small white Lines, in some measure tendinous, and very oblique; which all, together, represent a kind of Cancelli, the Areolæ or Meshes of which are very narrow.

As these Circles, or Segments, advance on the great Extremity of the Stomach, they diminish gradually, and form a kind of muscular Vortex, the Center of which is in the Middle of that Extremity.

Between the external and internal Laminae, round the superior Orifice, there are two distinct Laminae, about the Breadth of a Finger, and very oblique, which surround this Orifice in opposite Directions, and intersect each other on the two Sides.

Along the Middle of each Side of the small Extremity, there runs a tendinous or ligamentary flat Portion, above a Quarter of an Inch in Breadth, which terminates in the Pylorus. These

two Portions lie between the common and muscular Tunics, and adhere very strongly to the first.

Between the same two Tunics there is a cellular Substance, which adheres very closely to the external Tunic, and insinuates itself between the fleshy Fibres of the second, and all the Way to the third, as may be perceived by blowing it up. Some make it a distinct Tunic, and call it *Tunica Cellulosa*; but it is no more than the cellular Portion of the membranous Tunic, like the cellular Portion of the Peritonæum.

The third Tunic, commonly called *Tunica Nervosa*, sustains, on its convex Side, a very large reticular Distribution of capillary Vessels, and Nerves: On the concave Side it seems to be of a very loose Texture, and, as it were, spongy*, or filamentary; containing a great Number of small glandular Bodies, especially near the small Curvature and small Extremity of the Stomach.

The fourth Tunic of the Stomach is termed *Villosa*; because, when it swims in clear Water, some have imagined they saw something in it like the Pile of Velvet. The Antients called it *Tunica Fungosa*; and, perhaps, this Name agrees best with its true Structure. We observe in it a great Number of small Apertures, answering to the small Glands already mentioned.

These two Tunics are of a larger Extent than the two former; and they contribute in forming large *Rugæ* on the concave Surface of the Sto-

* This spongy Texture resembles fine Cotton; as may be seen, by macerating it a little in clear Water, which swells it considerably, in a very short Time. It is supported by a kind of Ground-work of very fine ligamentary or aponeurotic Filaments, which intersect each other obliquely, much in the same Manner as the third Tunic of the Intestines, of which hereafter; and it adheres to the convex Side of the villous Tunic.

mach; the greatest Part of which is transverse, though irregular, and waving. There are, likewise, some longitudinal ones, which intersect the others; but at the Pylorus they all become longitudinal, and terminate there.

At the superior Orifice of the Stomach these Rugæ are, in a Manner, radiated, and seem to be a Continuation of the Plicæ, or Folds, of the Oesophagus; only they are thicker, and where these Rugæ, or Plicæ, meet, they form a sort of Crown, which distinguishes the superior Orifice of the Stomach from the inferior Extremity of the Oesophagus.

In the Interstices of these Rugæ, there is often found a sort of slimy Mucus, which moistens the whole Cavity of the Stomach: This Mucus is much more fluid in living Bodies, and is supplied by the Glands of the Stomach. It may be termed Succus Gastricus, or Stomachicus.

On the interior Surface of the small Extremity of the Stomach, at the Place where it ends in the intestinal Canal, we observe a broad, thin, circular Border, with a roundish Foramen in the Middle: This Aperture is the inferior Orifice of the Stomach, called, by the GREEKS, Pylorus, which signifies a Porter.

This Border is a Fold, or Duplicature, of the two interior Tunics of the Stomach, the Nervosa and Villosa; and it is formed, in part, by a Fasciculus of fleshy Fibres, fixed in the Duplicature of the Tunica Nervosa; and distinguished not only from the other fleshy Fibres of the Extremity of the Stomach, but also from those of the Intestines, by a thin, whitish Circle; which appears even thro' the external or common Tunic, round the Union of the Stomach and Intestines.

The Figure of the Pylorus is that of a Ring transversely flattened; the inner Edge of which, or
that

that next the Center, is turned obliquely towards the Intestines, like a broad Portion of a Funnel. This inner Edge runs naturally, more or less, into little Plaits, or Gathers, like the Mouth of a Purse almost shut; very different from what Figures and dried Preparations would make us believe. It is therefore a kind of Sphincter, which can contract the inferior Orifice of the Stomach, but seems not capable of shutting it quite close.

The principal Arteries of the Stomach are, the Coronaria Ventriculi, which run along the small Curvature; and the two Gastricæ, that is, the Sinistra or Major, and Dextra or Minor; both which form one common Artery, which runs along the great Curvature.

The Coronaria Ventriculi becomes united in the same Manner with the Pyloricæ, and both make one common Vessel.

These two arterial Arches send a great Number of Branches towards each other on both Sides of the Stomach; and these Branches are gradually ramified, in different Directions, by very frequent Divisions and Subdivisions, the greatest Part of which communicate with those from the other Artery.

From these frequent Ramifications and Communications of the arterial Arches of the Stomach, two different reticular Textures arise; whereof one, which is the largest, lies between the common and muscular Tunics in the cellular Substance found there; the other, which is very fine, lies on the Surface of the Tunica Nervosa.

* By Injections we can shew a third extremely fine reticular Texture of capillary Vessels, which run between the glandular Bodies and Papille of the Tunica Villosa. These do not seem, in the natural State, to be pure Blood-Vessels, as Inflammations and Injections may induce us to think.

This latter is a Production of the first, being formed by means of a great Number of very short Rami, which go out from the other, and pass thro' the small Interstices between the Fibres of the muscular Tunic.

The Arteries of the Stomach come originally from the Cæliaca; by means of the Hepatica, Splenica, and Coronaria. The Pylorica and Mesenterica Superiora likewise contribute to them by Communications, more or less immediate. They communicate, also, with the internal Mammaric and Diaphragmatic, by means of the left Epigastric, with the inferior Mesenteric.

The Veins of the Stomach are Ramifications of the Vena Porta, in general; and, in particular, of the Mesaraica Major, Splenica, and Hæmorrhoidalis Interna; the Distribution of which may be seen in the Description of the Veins. They accompany the Arteries more or less, and form nearly the same kind of Arches, and reticular Textures; with this Difference, that they are proportionably greater, their reticular Areolæ larger, and their external Communications more frequent.

Between the common and muscular Tunics of the Stomach, we find a great Number of Nerves, of different Sizes: Many of them accompany each other, in Form of a flat broad Fasciculus, along the small Curvature of the Stomach, from the superior to the inferior Orifice: The rest are spread, in different Directions, on the Sides, Extremities, and great Curvature; forming, at different Distances, a kind of reticular Plexus, from which a great Number of Filaments are detached to the interior Tunics.

They arise, chiefly, from the Nervi Sympathetici Medii, or eighth Pair, by means of the Plexus Coronarius Stomachicus formed round the superior Orifice of the Stomach, by the Expansion of the
Extre-

Extremities of two large Ropes, which run down upon the Oesophagus, by the Name of *Nervi Stomachici*. The great Sympathetic Nerve, commonly called *Intercostalis*, contributes likewise to them, by communicating Filaments, which the *Plexus Stomachicus* receives from the Semilunar Ganglion of the *Plexus Hepaticus*; and, particularly, from the *Plexus Splenicus*.

Office of the STOMACH.

In the Capacity of the Stomach are conveyed Foods, sometimes crude, or in a tough State, and but little altered by Mastication; and those often of various Kinds, and Mixtures: Some of them being *alcalescent*, as *Flesh Meats*; *rancescent*, as *oily* or *fat Substances*; or *acescent*, as *Bread*, *Milk*, and most of the *Vegetable Kind*. These, we observe, are digested in a Heat equal to that of a hatching Egg; administered to the Stomach by the contiguous *Spleen*, *Liver*, and *superincumbent Heart*; and this in a Cavity altogether close or confined above; as it is also below, by the *Ascent* of the incurvated *Pylorus*, and its contractive muscular Valve. From whence we observe, that even *Milk* itself is often retained, in the Stomach of strong Animals, for several Hours after a Meal. Aliments are continually cohobated, or moistened, with watery Juices; and at the same Time replenished with a good deal of Air, incorporated with them, either naturally, or in the Mastication. This Air, therefore, expanding, by the Force of Heat, Putrefaction, or Fermentation, breaks open the Cells by which it was included, divides the viscid Liquors, and softens or opens the solid Fibres, so as to make a Way for discharging their Juices. But the same Substance of the Air, turning to a Solid, makes the principal Glue, or Cement, by which the animal Solids, and
other

other Bodies, receive their Firmness: And this, being extricated by Heat, leaves the other elementary friable Particles without a Vinculum; as we see, from the Change of bony Substances in PAPIN's Digester, in the Stomachs of many Animals, and even in those of ourselves. This Air, set at Liberty, by Digestion, often distends the Stomach, more than the Food itself, under the Denomination of Wind, or Flatus. Whilst this Air is extricated, the Aliments, by long Stay, begin to corrupt, or change into a nauseous Liquid, either acid, mucous, putrid, or rancid; which two last happen less in human Bodies, from our Use of Bread, Salt, Wine, &c. For the Truth of which, we may appeal to the Flatus, and Matters eructated, often of a most foetid, caustic, and inflammable Nature, from Substances of the like Disposition. This Putrescency, or imperfect Putrefaction, is almost the only Cause of Digestion, in Fishes, Serpents, and Carniverous Birds: Even in human Bodies we see, that Metals themselves are, from these Causes, corroded, and dissolved.

At this Time Hunger is absent, the nervous Plaits of the Stomach being removed, and defended from their Contacts with each other, by the interposed Aliment, at the same Time that the Juice of the Stomach itself is less sharp, and freer from a Mixture with the old Remains of the last Food; which often excite a nauseating Uneasiness in the Nerves of the Stomach.

But that the Aliment might not degenerate into a complete Corruption, or Acrimony, for the most Part of the acid Kind; there is a Check from the putrescent Degree of the Heat, the Quantity of Juices, distilling from the Stomach, and that of the Saliva itself swallowed to the amount of Half an Ounce in an Hour, and rather inclined to an Alca-

30 Of the Oesophagus Lect. II.

Alcalescency: Also, these Juices, being ground together with the Aliment; macerate, soften, and dissolve, the Fibres themselves, and their cellular Laminæ; leaving them a soft Pulp, like what we see, by letting them remain, for some Time, in warm Water.

There is, therefore, no particular Kind of Ferment, in the Stomach, from which the Design of Nature, the Disposition of the Stomach, and its Use, are all very remote.

The nervous Fibres in the Stomach, being now irritated by the Flatus, Weight and Acrimony of the Food; begin to contract themselves more powerfully than when the Stomach is empty, and with a greater Force, in Proportion as it is fuller: Because the Expansion, every Way, serves the Fibres as an Hypomocion, or Point for Motion. And, first, the muscular Stratum, which passes along the lesser Curvature, connects the Pylorus with the Oesophagus; and, being inserted only into the left Face of the former, draws it to the right. The principal Stratum of the muscular Fibres contracts the Capacity of the Stomach, according to its Length, grinds or intermixes its Contents, together with the Juices, and determines them both, like the Pressure of so many Fingers, to flow towards the Pylorus. But this Flux, through the Pylorus, is not perpetual; because the Motion begins from some Part which is more irritated; and from thence the Aliment is driven here upwards, as in other Parts downwards. In this Action of the Stomach, there is nothing which resembles the Triture made by the strong Gizzards of Granivorous Fowls, which some Anatomists have ascribed to the human Stomach; which, yet, has a considerable Degree of Strength; since the Contraction of its Fibres is often more than a third Part of their Length: For we frequently

quently see the Stomach reduced to less than a third Part of its Diameter, even to the Quantity of a few Ounces, with a Collapsion of its Sides.

But the stronger peristaltic Motion of the Stomach is that which it receives from the Diaphragm and abdominal Muscles: For, by the Pressure of these, the Stomach is more perfectly emptied, by a close Approximation of its anterior and posterior Sides. As it is principally by this Force, that Drinks are urged on continually, but Foods only when they are dissolved; lest those Parts, which are too gross, should be expelled through the Pylorus into the Duodenum, when the Stomach is more that Way inclined by Repletion: For the solid Aliments do not seem to leave the Stomach, before they have changed their fibrous, or other Texture, for that of a grey Mucus; dissolving into a yellowish and somewhat foetid Pulp, like a Liquid. That which is first prepared, and turned fluid, goes, before the rest, out of the Stomach: First, Water; then Milk, Pot-Herbs, Bread, and, last of all, Flesh Meats; the harder, tougher, and longer Skins or Fibres of which pass unchanged. But such Things, or Bodies, as are hard, or too large to pass the Pylorus, are retained in the Stomach for a long Time*.

But as a considerable Portion of the Drink is absorbed, by the inhaling Veins of the Stomach itself, which open in the pendulous Villi, and exert a Force like that of capillary Tubes or Siphons, and are corresponding to the exhaling Arteries of the same Part; so their Contents take a more immediate or short Way into the Blood; as plainly appears, from repeated Experiments of injecting the Veins. Whether any Part may pass into the lymphatic Vessels, is doubtful.

* See Dr. AREUTHNOT'S Essay concerning the Nature of Aliments, &c.

The Stomach being irritated by too great a Quantity or Acrimony of the Food, or else by Sicknefs, a Repulfion of the Bile, or other Cause, does, by an antiperiftaltic or reverted Motion of its Fibres, drive its Contents upwards; through the open and relaxed Oesophagus, in the Act of Vomiting.

But then this Effect is partly from the Preffure of the abdominal Mufcles depressing the false Ribs, and urging the Contents of the Abdomen againft the Diaphragm; which, at the fame Time, contracting itfelf to a Plane downwards, forces the Stomach, in a Manner, as betwixt the Sides of a Prefs, to throw up its Contents.

But the Aliments driven, in their natural Courfe, through the Pylorus to the Duodenum, meet there with the influent Bile and pancreatic Juices, which often flow back into the Stomach. But the former of thefe, being the principal Basis of Chylification, will require from us a previous History of the Vifcera, which convey their Blood through the Vena Porta, for the Secretion or Formation of the Bile, before we can proceed to inquire into the Nature and Effects of that powerful Humour.

Lymphatic Veffels, I have obferved, are fometimes very confiderable, about the leffer Curve of the Stomach, arifing from the Glandula of that Part; and inferted, by a very large Trunk, into the Thoracic Duct: Others, no doubt, arife from fmall Glandules, of the fame Kind, in the greater Curve. As to the other lacteal Veffels, more than thefe in the Stomach, I have never been able to fee them; nor do I think they exift: Particularly thofe lately described, and faid to pafs from the Stomach, through the Omentum, to the Liver, filled with a true Chyle.

Within the human Stomach we firft meet with a great Quantity of Mucus, fpread upon its vilious Lining, from the Pores; which Mucus is not unfrequently tinged, by fome of the Bile returning
into

into the Stomach. Besides this, in an empty Stomach, after fasting, upon bending the Body, a great Quantity of limpid or watery Humour will rise into the Mouth, exactly of the same Nature with the Saliva; which Liquor is very rarely to be found pure, or unmixed, in the Stomach: For if it can be so had, free from any Mixture of the Food, it is far from possessing any acid or alkaline Acrimony: But, on the contrary, if it be free from acid or acescent Relics of the Food, it spontaneously changes, both in Man and Brutes, rather to a lixivial or alkaline Nature. This Liquor distils from the Arteries of the Stomach, through its villous Tunic, after the Manner we see by anatomical Injections; which is easily urged into the Vessels of the Stomach, so as to perspire through its Infinity of Pores.

The Stomach, then, contained within the Abdomen, which is perfectly full, will, from thence, as in a Press, receive a Force, or Pressure, upon its Sides, which lie betwixt the Diaphragm; the Concavity of whose right Wing is filled by the Liver; under which, and within the left Wing, lies the Stomach, extended almost transversely behind the resisting abdominal Muscles. The more the Stomach is filled, the more it is urged by this Pressure of the Muscles; because, at the same Time, it rises upwards, in a right Angle, to the Contact of the Peritonæum.

Possibly, also, the Stomach absorbs and retains the more subtil Particles of what it has thus prepared for Nutrition, especially in Women giving Suck; by conveying it into their Mamillæ by some minute Canals, which are imperceptible when empty, like some of the lymphatic Vessels.

It is also the Organ in which the Sensation of Hunger resides. HALLER's Physiol.

The Signs of an Inflammation of the STOMACH. These generally are, a burning, fixed, and pungent Pain; an Exacerbation of this Pain, every Time any Thing is taken into it; a painful Vomiting, immediately after eating and drinking, accompanied with a tormenting Hiccough; a violent and perpetual Uneasiness about the Præcordia, with an acute continual Fever. The Causes of this Disorder are, either general Inflammations; the Contiguity of the Stomach to other inflamed Parts; or by taking in some acrid Substances, &c. It very often soon proves mortal, unless expeditiously cured, like other Inflammations. It terminates either in Health, or in suppuratory, scirrhus, cancerous, gangrenous Disorders; or sudden Death, by violent Convulsions. BOERHAAVE's Aphorisms.

OBSERVATIONS.

The Stomach is, in general, larger in Men, than in Women; yet I found the Stomach of a young Woman of an enormous Capacity.

We ought not to be surpris'd, if the Stomach, when considerably augmented in Bulk, descends lower than the epigastric Region, and even reaches below the Navel; as I have before observed. But it appears surpris'ing, that, even in small Wounds of the Diaphragm, the whole Stomach should slip into the Thorax: This, however, has sometimes happened. AMBROSE PARE says*, that in the Breast he found the Stomach, which had passed through a Wound in the nervous Center of the Diaphragm, which was not much above an Inch long. FABRICIUS HILDANUS † relates a similar

* On Wounds in particular, Lib. X.

† Obs. Centur. 4. Obs. 33.

Observation: And what is still more surprising is, to find the Stomach in the Thorax without any Mark of a Wound in the Diaphragm. RIVERIUS says*, that, in the right Part of the Breast, he found the Stomach possessing the Place of the Lobe of the Lungs, which was wanting on that Side, and the Person never felt the Effects of this preternatural Situation of these Organs; having, for a long Time, enjoyed a perfect State of Health.

THOMAS BARTHOLINE also says†, that in the Breast he found the Stomach covered with the Epiploon. There is great Reason to believe, that these two last extraordinary Cases depended on a Fault of the first Conformation. I shall here add a third preternatural Case, which also appeared to depend on a Fault of the first Confirmation.

Mr. MOUTON junior‡, opening a Fœtus of nine Months, was surpris'd, on opening the Abdomen, not to find the Stomach, nor Spleen; but, on opening the Thorax, he found the Stomach and Spleen, of the left Side, possessing the Place of the Lobe of the Lungs, which was wanting on that Side, and of which there was no Mark. Having examined the Diaphragm, he found an extraordinary Aperture of about an Inch and an Half in Extent, and situated at the Side of that which affords a Passage to the Oesophagus: He also found, that one Lobe of the Liver, which was almost separated from the rest, had passed through this Aperture.

Mr. COURTOIS§, who was present at this Dissection, says, that he saw this particular Phænomenon, with all its Circumstances.

* RIVERIUS Obs. Centur. 4. Obs. 67.

† Vide THO. BARTHOLINE Hist. Anat. Centur. 6. Hist. 55.

‡ Surgeon of the Chirurgical Academy of Paris.

§ Ibid.

36 Of the Oesophagus Lect. II.

After long Abstinence, and severe Pains, the Body is not only much emaciated; but sometimes, also, the Stomach, with the Intestines, were so contracted, that they are no larger than the Intestines. FRED. RUYSCH's Observ.

A middle-aged Man, in low Circumstances, tall, corpulent, and of a very good Habit of Body, who wilfully starved himself to Death in a Stable: In dissecting him, I found all the Parts perfectly sound; but the Stomach and Intestines were entirely empty, without the least Remains of Excrement: The Bile was in great Quantity, so as not only to tincture the adjacent Viscera, but to fill a considerable Part of the Intestines. The Size of the Omentum was larger than any I ever saw; being an Inch thick; and it retained the Impression of the Intestines: The Mesentery and Mesocolon were very fat. In the Stomach, which was likewise tinctured internally with the Bile, there was, near the Pylorus, a great many Orifices of the muciferous Glands, about the Bigness of Pins Heads, which, when squeezed, emitted the contained Mucus. From hence it appears, that the Fat of a healthy Person is not very soon consumed, even after extreme Inanition; and that the Bile may likewise be squeezed out of the Gall-Bladder without any swelling of the Stomach. HALLER's Patholog. Obs. 24.

In the Body of a Woman, the Peritonæum, Stomach, Duodenum, Colon, Gall-Bladder, and Liver, were all grown together in one confused Mass; shooting out, on all Sides, small white Fibres, which degenerated into a thick and soft Body; by which the above Parts were, in a Manner, glued together. So strong was the Cohesion, that the Colon could not be separated from the Stomach; and there was an open Passage, from that Intestine to the Stomach, formed by an Ulcer. Hence the
Colon

Colon was empty, and the Stomach, in the Part contiguous to the Colon, was very much disfigured by scirrhus Tumors and Abscesses, but had a sound coronary Orifice. Upon inquiring into the Disease, I was told, that, about eight Years before her Death, she was seized with an Illness, during her Lying-in, of which she never perfectly recovered; and could neither speak plain, nor bear any solid Food ever after: But most of her Sustenance had been small Beer, which supplied her just with sufficient Strength to beg about the Town. HALLER's Pathol. Obs. 23.

A large Crypta of the Stomach, found in a Woman of about Sixty-four Years of Age. According to her Daughter's Account of her, she had been subject to complain of Pain in her Breast, lost her Senses, was much troubled with Worms, and frequent Bleeding at the Nose. It was evident, that the Catastrophe had been finished by a Dropsy, whereby the subcutaneous cellular Membrane, which invests the Muscles, and that lines the Thorax, Pericardium, and Abdomen, were rendered turgid with Water. The Ventricles of the Brain were less affected. The Lungs, which is often the Case, had large Adhesions with the Mediastinum, Pericardium, and Diaphragm; the Aorta was full of Callosities, which are frequent enough in old Subjects; and the Intestines swarmed with Worms: In the inferior Orifice of the Stomach there were ten or twelve hemispherical Tubercles, resembling Nipples, produced by the villous Tunics; the Points of these Tubercles were either black, or quite perforated; their Cavities full of Pus, and their Dimensions very different; some of them being about three Lines in Diameter, and others an Inch. This was a very singular Case; and affords a Conjecture, whether the Disease was owing originally to the Worms cor-

38 Of the Oesophagus, &c. Lect. II.

roding the Stomach, or to an Obstruction of the Cryptæ of the Stomach, which these Tubercles resembled very much in their Figures, but they were greatly increased in Size. Her Appetite and Digestion continued pretty good. HALLER's Pathol. Obs. 22.

A young Man received a Kick in the Belly, which occasioned a continual Pain in the anterior Part of his Abdomen, with a great Weakness of Digestion; and these Symptoms were succeeded by a slow Fever, which at last proved mortal. Upon dissecting his Body, the Omentum was, as it were, folded up, and about an Inch and a Half thick. It adhered very firmly to the Liver and Stomach. Within it was a foetid putrid Pus, and the very Substance of the Stomach was turned to a kind of gummy bloody Cancer. Ibid. Obs. 25.





LECTURE III.

Of the general Situation, Size, and Division, of the INTESTINES.

FROM the Pylorus to the inferior Part of the Abdomen, lies a long Tube, bent into various Directions and Convolution, called the Intestines.

This Tube, or Canal, thus folded, fills the greatest Part of the abdominal Cavity; and it is connected, through its whole Extent, to membranous Productions or Continuations of the Peritonæum; but principally to those called the Mesentery and Mesocolon.

This Incurvation of the intestinal Canal forms two Arches: A small one, by which it is connected to the Mesentery and Mesocolon; and a large one, on the opposite Side, which lies loose. The whole Canal is generally said to be about six Times as long as the Subject duly proportioned.

This Canal is neither of an equal Size, nor Thickness, through its whole Length; whence Anatomists thought proper to divide them into *Tenuia*, or small; and *Crassa*, or great.

They likewise subdivided each Class into three Portions, which they distinguished by particular Names. The small ones are, *Duodenum*, *Jejunum*, and *Ileum*; the great ones, *Cæcum*, *Colon*, and *Rectum*.

Structure of the INTESTINES. In general they are composed of several Tunics, much in the same Manner with the Stomach. The first exterior is a Continuation of the Mesentery, or of some other Elongation or Duplication of the Peritonæum.

This is generally termed the common Tunic; and it has a cellular Substance, on its interior Surface, like that of the Stomach; which RUYSEN thought fit to call a distinct Tunic, by the Name of Tunica Cellulosa.

The second Tunic is muscular, and forms two Laminæ; one external, the other internal.

The external is very thin, and its Fibres longitudinal; the internal is thicker, and its Fibres run transversely round the Circumference of the intestinal Cylinder.

These two Laminæ adhere closely together, and are not separated without great Difficulty: They likewise adhere to the common Tunic, by the Intervention of the cellular Substance, which is in greater Quantity on the Side next the Mesentery, than on the other.

The third Tunic is called Nervosa, and is somewhat like that of the Stomach. It has a particular Lamina, which serves as a Base to sustain it, consisting of very fine, strong, oblique Fibres, which seem to be of the ligamentary or tendinous Kind.

To inspect this Lamina distinctly, a Portion of the Intestines must be inflated, and the common Tunic removed, with the muscular Fibres scraped.

* DR. WINSLOW is not of Opinion, that these Fibres are spiral, nor that they are perfect Circles, or Rings: But they seem rather to be Segments of Circles, disposed much in the same Manner as those of the Stomach, and surrounding intirely the intestinal Canal.

This Tunic retains two reticular Substances, which are both vascular; one arterial, the other venal; accompanied by a great Number of nervous Filaments. These Vessels and Nerves are Productions of the mesenteric Vessels and Nerves: And as they surround the whole intestinal Canal, some Anatomists have formed them into a distinct Tunic, by the Name of *Tunica Vasculosa*.

The nervous Tunic sends off from its inner Surface a great Number of Portions of Septa, more or less circular, which contribute to the Formation of what are called *Valvulæ Conniventes*: It likewise seems to sustain several different glandular Bodies which are discovered in the Cavity of the Intestines.

The fourth, or interior Tunic, is very soft, and named *Tunica Villosa*. It has the same Extent with the third Tunic, which supports it; and it lines all the Septa of that third Tunic; but it is not uniform through the whole Canal, as we shall shew, in its particular Description.

THE INTESTINA TENUIA. The small Intestines form one continued uniform Canal: And though three Portions of it have three different Names, yet we have no sufficient Marks whereby to distinguish them, to fix the precise Extent or Length of each Portion, or to settle its just Limits.

The first and smallest, or, properly speaking, the shortest Portion of the whole Canal, is called *Duodenum*; the second, which is much longer, *Jejunum*; and the third, which is still longer than the second, *Ileum*.

Situation, Connection, and Structure, of the *DUODENUM*. The first Portion of this Intestine was called *Duodenum*, from the Length ascribed to it by the Antients; viz. the Breadth of twelve Fingers: And the Moderns need not cavil much
about

about this Length, if it is measured with the Ends of the Fingers of the Subject.

This Intestine having arisen from the Pylorus, is immediately bent a little backwards, and obliquely downwards; then it bends, a second Time, towards the right Kidney, to which it is a little connected; and from thence passes before the renal Artery and Vein, ascending, insensibly, from right to left, till it gets before the Aorta; and, lastly, the dorsal Vertebra. It continues its Course obliquely forward, by a gentle Turn, which may be reckoned a third Incurvation, and also the Extremity of the Duodenum.

Through its whole Course it is firmly bound down by Folds of the Peritonæum, especially by a transverse Duplicature which gives Origin to the Mesocolon. The two Laminæ of this Duplicature, being at first separate, and soon after uniting, must leave a triangular Space between them, which is lined with a cellular Substance.

It is in this Space that the Duodenum adheres, by means of the cellular Substance, to the Parts already named; and the Intestine is contained therein, as in a Case: So that, without Dissection, we can see nothing but its two Extremities; and even these are hid by the Colon, and the first Convolution of the Jejunum.

The first Tunic of the Duodenum is, consequently, different from that of the other small Intestines; having this peculiar to it, that it does not invest the whole Circumference of the Intestine; because, through the greatest Part of its Length, it lies in the triangular Space already mentioned: And, for the same Reason, there is a greater Quantity of cellular Substance belongs to the exterior Tunic of the Duodenum, than to that of the other Intestines.

The muscular Tunic is thicker than that of the Jejunum, or Ileum.

The Tunica Nervosa and Villosa form conjointly, on the Insides of this Intestine, a great Number of small Duplicatures, which advance to the Cavity more or less directly, like Portions of circular Planes, with one Edge fixed to the Intestines, and the other loose: These are what Anatomists call *Valvulæ Conniventes*.

The loose or floating Edge of these Valves is formed into small Gathers, or Valves, in the natural State. I say designedly in the natural State, to rectify the false Ideas which dry Preparations of the Intestines are apt to beget. The whole Surface of these Duplicatures, or Valves, is villous, as well as that of the Interstices between them.

The Villi of this Intestine are thicker than in the Stomach; but the Texture of them in Man, is not like Hairs, as they are commonly represented in Figures; but rather like that of a fungous, granulated Substance, composed of an infinite Number of very fine *Papillæ*, of different Figures, in which we see, through a Microscope, a Multitude of depressed Points, or Pores, by which their whole Surface seems to be pierced.

By the same Help, we observe, on different Places of the inner Surface of this Intestine, several round villous Tubercles, rising, like small *Verrucæ*, at different Distances from each other.

This Substance sustains an infinite Number of capillary Vessels, of different Kinds: For, besides the Blood-Vessels, we sometimes observe a great Number of white Filaments, which run through it, and end at its inner Surface, like so many capillary Roots of the Vessels called *Venæ Lactææ*.

The fungous Substance which binds these capillary Filaments together, and surrounds them, is
very

very tender; and the capillary Extremities of the small Blood-Vessels, distributed through it, seem to be turned towards the Pores of the Papillæ. Through these Pores, a mucous Fluid, more or less transparent, is discharged, which continually moistens the Cavity of the Intestine.

Glands of the DUODENUM. The internal Surface of the Duodenum is furnished with a great Number of small, flat, glandular Tubercles, raised on the Sides, and depressed in the Middle, by a kind of Fossula; and they are more numerous near the Beginning of this Intestine, than anywhere else.

About the Pylorus, they lie, in a Manner, in Heaps, or Clusters; and from thence the Distance between them increases gradually, all the Way, to the other Extremity, where they are single.

These Glands, when examined carefully, appear like little Bladders, with the Orifices turned towards the Cavity of the Intestine, and the Bodies fixed in the spongy Substance next the nervous Tunic. They furnish a particular Fluid, which is often found to be viscid.

On the internal Surface of the Duodenum, almost at the inferior Part of the first Incurvation, and on the shortest Side, there is a longitudinal Eminence; in the Point or Apex of which lies the Orifice of the Ductus Biliaris, within which the Ductus Pancreaticus likewise opens.

This Intestine is commonly the widest, though the shortest of the Intestina Tenuia, and is invested by more cellular Substances, especially while within its triangular Cases, where it wants the exterior Tunic, which the others have; and, consequently, it is more easily dilatable, by the Substances which might otherwise stick within it.

Situation, Size, and Structure of the JEJUNUM. This Intestine is so called, because it is oftener found more empty than the Ileum, which begins at the last Incurvation of the Duodenum, where it is connected to the Beginning of the Mesocolon.

From thence it bends downwards from left to right, and obliquely forwards, or from the Vertebrae; and makes several Convolutions, which lie chiefly in the superior Part of the umbilical Region. Through all this Course, it is connected to the Mesentery.

It is a pretty difficult Matter to fix the exact Bounds between this Intestine and the Ileum. The external Marks being of a redder Colour in one than in the other, though pretty common, are not constant; and the internal Marks, fixed from the Plurality of Valvulae Conniventes, are indeterminate, and oftentimes appear only from Dissection.

The Tunics of the Jejunum are nearly of the same Structure with those of the Duodenum, but thinner. The common Tunic is a Continuation of the Mesentery; and the cellular Substance is in less Quantity than in the Duodenum; and indeed seems to be altogether wanting along the great Curvature of the Convolutions, where the longitudinal Fibres of the muscular Tunic adhere very closely to the external Membrane.

This muscular Tunic is not so strong as that of the Duodenum. The longitudinal Lamina of Fibres is very thin, and almost imperceptible, except along the great Curvature opposite to the Con-

* These two Intestines may be better distinguished by their different Situations, which are pretty regular: But as even this Mark is not particular enough, the easiest Way that I have been able to contrive, and which will, in most Cases, be found sufficiently exact, is, to divide both the Intestines into five Parts; and to allow nearly Two-fifths to the Jejunum, and a little more than Three-fifths to the Ileum.

nection of the Mesentery, where we see through the membranous Tunic a kind of whitish ligamentary Band, about the third Part of an Inch in Breadth, which is continued along the great Curvature of all the Convolutions of this Intestine, and of the Ileum.

This ligamentary Membrane is like those which we observe on the Sides of the small Extremity of the Stomach. It adheres perfectly to the membranous Tunic, and to the longitudinal Fibres of the muscular Tunic, which are here more visible, and appear to be stronger than in any other Place.

The Tunica Nervosa, which I choose rather to call Reticularis, and its proper cellular or lanuginous Substance, have nothing peculiar to them more than has been already said about the Intestines in general. By blowing artfully into this Substance, it may be made to swell so much, round the whole Cavity of the Intestine, as to destroy all the Duplicatures, or Valvulæ Conniventes.

These Valves, in this Intestine, are very broad, numerous, and very near each other. On the Side of the great Curvature their Circumference is continuous, and uniform; but next the small Curvature there are several Breaks in them; the Extremities of some advancing beyond the rest, and terminating in Pores. Some of these Valves go quite round, others only some Part of the Way, and some of them are very small, which go obliquely between two large ones, forming a kind of Communication.

The Papillæ * of the Tunica Villosa are here more raised, loose, and floating, than in the Duodenum; and each of them seems to be divided

* The Observations and Figures, published by Dr. HELVETIUS, in the Memoirs of the Royal Academy of Sciences, express these Papillæ, and the whole Tunica Reticularis, very justly. Dr. WINSLOW.

into several others, by Incisures of a very singular Kind: In other Respects they agree pretty much with what was said in the Description of the Intestines in general.

The glandular Lacunæ of the Jejunum are of the same Structure with the Glandulæ Bruneri, or Duodenales; but they are disposed in a different Manner. They are partly single, at different Distances from each other; and partly in several Clusters, like flat oblong Bunches of Grapes, called Plexus, Glandulosi Peyerî.

These are in the largest Quantity near the great Curvature, and they cross through several Valvulæ Conniventes at once.

Situation and Structure of the ILEUM. The Convolutions of this Intestine surround those of the Jejunum on the two inferior Sides; and it passes, in a winding Course, from the left Side, by the Hypogastrium, to the right, where it terminates a little below the right Kidney; joining the Intestina Crassa in the Manner which I shall relate hereafter. The lateral Convolutions are supported by the Ossa Ilium; so called, not from this Intestine, but from the Region of the Abdomen termed Iliâ.

The Structure of the Ileum is much the same with that of the Jejunum; only the internal Duplicatures, or Valvulæ Conniventes, decrease gradually, both in Number and Size. Near the Extremity of the Ileum their Direction is changed; and, instead of being transverse or circular, they become longitudinal, and terminate in a kind of Pylorus, which advances into the Cavity of the great Intestines, as we shall see presently.

We observe likewise, in this Intestine, as in the Jejunum, single or solitary Glands, or Lacunæ; and also reticular Glands, or Glands in Clusters, the last of which, at the Extremity of this Intestine,

tine, is oftentimes of great Extent; but the greatest Part of these Glands appear to be flatter here than in the Jejunum. The cellular Substance of the external Tunic is in less Quantity than in the foregoing Intestines, and the Ileum commonly appears paler than the Jejunum.

The Vessels, Nerves, Connections, &c. must be referred to the History of the Mesentery.

INTESTINA CRASSA in general. The great Intestines are one continued Canal, divided into three Portions, like the small ones: This Canal begins by a kind of Sacculus, or Bag, which is reckoned the first of the three Portions, and called Cæcum.

The second Portion, called Colon, is the longest of the three; and is distinguished from them by a great Number of particular Eminences, or Convexities, which appear on its external Surface through its whole Length.

The last Portion is named Rectum; being more uniform, narrower, thicker, and much shorter, than the Colon.

The Structure of the great Intestines is nearly the same with that of the small ones, in regard both to the Number and Disposition of their Tunics. They are shorter, and have fewer Convolutions; but are much more capacious. The Tunics in general are stronger, especially the muscular ones; the Villi and mucilaginous Glands are different; and there are several other Things, relating to them, which will be described in their proper Places.

Situation and Structure of the CÆCUM. The Intestinum Cæcum is only a round, short, broad Bag, the Bottom of which is turned downwards, and the Mouth, or Opening, upwards: It lies under the right Kidney, and is hid by the last Convolution of the Ileum. It is about three Fingers Breadth

Breadth in Length, and its Diameter is more than double that of the small Intestines.

APPENDICULA VERMIFORMIS. On one Side of the Bottom of the Cæcum lies an Appendix resembling a small Intestine, nearly of the same Length with the Cæcum, but very slender. It is termed Appendicula Vermiformis, from its supposed Resemblance to an Earth-Worm. Its common Diameter is not above a Quarter of an Inch. By one Extremity it opens laterally, and a little obliquely into the Bottom of the Cæcum; and the other Extremity is closed; being sometimes greater, sometimes smaller, than the rest of the Appendix.

It has some Contortions, like those of a Worm when it is touched; from whence comes the Epithet, Vermicularis, or Vermiformis: And it may likewise be compared to the Gills or Pendants of a Turkey Cock. Its Structure resembles nearly that of the other Intestines.

The internal Tunic of this Appendix is folliculous, like that of the Duodenum; and it is likewise reticular, the Meshes being the glandular Lacunæ, which continually discharge a Fluid into its Cavity.

It has been often disputed, whether this Appendix, or the larger Portion, which is, as it were, the Head of the Colon, ought to be called the Cæcum: But the general Division of the Intestines into great and small, leaves no room to doubt of its being only an Appendix in Man; whatever Reason there may be for talking differently with respect to Brutes and Birds.

Through the membranous or common Tunic of the Cæcum, we find three ligamentary Membranes, which adhere very closely both to the external and muscular Tunic. One of them is hid by the Adhesion of the Mesocolon; and all the

three divide the Cæcum longitudinally into three Parts more or less equal.

They all unite on the Appendicula Vermiformis, and cover its whole exterior Side immediately under the common Tunic. Though they appear exteriorly on the Cæcum to be ligamentary, they are made up interiorly of fleshy Fibres, which accompany and strengthen the longitudinal Fibres of the muscular Tunic.

The villous Substance of the interior Tunic of the Cæcum is very short, and furnished, in several Places, with glandular Lacunæ, or solitary Glands, broader than those of the small Intestines.

These glandular Lacunæ, or Folliculi, are flattened and depressed in the Middle, like the Small Pox. When we blow through a Pipe into these Lacunæ, without touching them, the Folliculi are inflated, and represent little Caps, with an Aperture in the Middle of the convex Side.

Situation and Structure of the COLON *. The Colon is the most considerable of all the Intestines. From the Cæcum, of which it is a Continuation, it reaches, in Form of an Arch, above the umbilical Region, to the inferior Part of the left Hypochondrium. Its Continuity is, however, a little interrupted by the Ileum, which advances into the Cavity of the Colon, and, together a certain Fold of that Intestine, forms what is called Valvula Coli.

The whole convex Side of the Colon is divided longitudinally into three Parts, by three ligamentary Membranes, continued from those of the Cæ-

* A monstrous Dilatation of the Intestinum Colon, in a Girl of five Years old: On opening her Body, we could hardly perceive any of the abdominal Viscera, except that Part of the Colon where it begins to assume the Name of Rectum; by reason of the enormous Extension of the Colon, under which all the Viscera lay concealed. RUYSCU, Observ. 92.

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cum, and of the same Structure with them. Two of these membranous Ligaments run on each Side along the great Curvature of the Colon, and the third along the small Curvature.

The superior ligamentary Membrane, of the two which belong to the great Curvature, is the broadest of the three; that which belongs to the small Curvature is the narrowest, and lay hid, by the Connection of the Mesocolon, till it was brought to light by MORGAGNI.

These three longitudinal membranous Ligaments do the Office of longitudinal Fræna, between which this Intestine is, through its whole Length, alternately depressed into transverse Folds, and raised into considerable Eminences. All the Folds are Duplicatures, which form Portions of Valvulæ Conniventes in the Cavity of the Intestine; and the Eminences form Receptacles, called the Cells of the Colon.

All the Tunics of the Colon concur equally to the Formation of these Duplicatures and Cells, the Depth of which decreases gradually towards the Extremity of the Intestine; and neither of them go any farther than the ligamentary Membranes.

These Portions of the Colon, which are immediately covered by the ligamentary Membranes, are smooth, and without Rugæ; and therefore if these Membranes, alone, are cut cross-ways, the Intestine is not elongated sufficiently to destroy all the Folds and Cells.

The common Tunic on one Side is a Continuation of the Mesocolon, and on the other Side it contributes, by the same Continuation, to form the Omentum.

The longitudinal Fibres of the muscular Tunic are very slender; and those which answer to the annular or circular Fibres of the small Intestines,

are only Segments stretched over the Eminences and Folds: The other Tunics are nearly as in the Cæcum; only the glandular Lacunæ, or solitary Glands, are broader, and more numerous.

The Arch of the Colon begins under the right Kidney. It runs up on the anterior Side of that Kidney to which it is connected; passes under the Vesicula Fellis, which tinges it with a yellow Colour at that Place, and continues its Course before the first Incurvation of the Duodenum, to which it adheres, and partly hides it. In this Part of its Course, therefore, there is a remarkable Connection between the Colon, Duodenum, right Kidney, and Vesicula Fellis.

From thence the Arch of the Colon runs before the great Convexity of the Stomach, and sometimes a little lower; then turns posteriorly under the Spleen in the left Hypochondrium, and runs down on the anterior Side of the left Kidney, to which it is connected; below this Kidney turns towards the Vertebrae, and terminates there by a double Incurvation, or by two opposite Convolutions, which represent, in some measure, a Roman S.

These last Convolutions of this Intestine are sometimes multiplied, and even advance to the right Side of the Pelvis; and along the great Arch, and the two last Incurvations, there are a kind of Fringes, called Appendices Coli Adiposæ, which I shall hereafter explain, as also the Connections of the Colon with the Mesocolon and Omentum.

VALVULA COLI*. At the Place where the

* In the Medical Essays, Vol. IV. Art. 31. is given an Instance of the Passage, at the Valve of the Colon, being shut up, and about two Fingers Breadth of the Intestine there was grown into a hard solid Substance, below which were no Folds. The small Intestines were much inflamed and hard.

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Cæcum joins the Colon, one Portion of the Circumference of both is depressed, and forms a large Fold on the Inside, which advances into the Cavity of the Intestine. It is a little open in the Middle, and its Extremities are very thick, by reason of the mutual Duplicature of the Tunics of the Cæcum and Colon.

The Extremity of the Ileum is, as it were, grafted in the Opening of this Fold, and strongly united to its Sides by the Adhesion of its transverse Fibres, to the transverse Fibres of the Cæcum and Colon.

This Union forms a pretty thick Ring, which likewise advances into the common Cavity of the Cæcum and Colon, where it is wrinkled, or formed into Gathers, almost like the inferior Extremity of the Oesophagus, the Pylorus, or Inside of the Anus. Its Circumference is more or less oval; and, by a kind of Continuity with the common Fold of the Cæcum and Colon, it forms two Productions, which MORGAGNI calls the Fræna of the Valvula Coli.

The membranous Tunic of the Extremity of the Ileum is continued on the Cæcum and Colon, without sinking into any Fold, at the Place where the Ileum enters the Colon. The longitudinal Fibres of the muscular Tunic seem here to be confounded with the nearest circular Fibres of the Cæcum and Colon.

The interior Portion of the muscular Tunic of the Ileum runs in between the circular Fibres of the Ileum and Colon, as into a common Fold of these two Intestines; from all which a pretty thick short Portion of a fleshy Tube is formed, which is the circular Rising already mentioned.

The Tunica Nervosa and Villosa, of the Extremity of the Ileum, likewise enter the common Cavity of the Cæcum and Colon, and on the Edge

of the circular Rising join the like Tunics of these two Intestines, so that the circular Rising, or short muscular Tube, is covered, both on the exterior and interior Sides, by a nervous and villous Tunic; that on the Inside being supplied by the Ileum, and the other by the two great Intestines *.

The Situation of the Extremity of the Ileum is commonly transverse, and inserted almost in the same Direction, in the common Cavity of the two Intestines already mentioned, but it is often a little more inclined towards the Cæcum, than to the Colon: And whereas in all other Places the Ileum is wide, and easily dilated; it is very narrow at its Insertion, and its Sides more solid and firm.

It is chiefly in this Structure that the Mechanism of the Insertion of the Ileum, in the Cæcum and Colon, consists; about which Insertion, or Opening, Authors are very much divided; some reckoning it a Valve, others only a Sphincter.

It is very evident, from what has been said, that it is a double Machine, contrived to hinder the Return of the Excrements into the Ileum; because it can produce this Effect partly as a Valve, and partly as a kind of Sphincter. The dried Preparations of this Part give a very false Idea of its Structure and Conformation; and the same Thing is to be said of the Opening of the Appendicula Vermiformis into the Cæcum.

The capacious Arch of the Colon is connected, by both Extremities, to the lumbar Region, near the Kidneys, by two particular membranous Ligaments, one on the right Side, the other on the left; which are only small Duplicatures of the Peritonæum, more or less transverse.

* The best Method to demonstrate the Structure and Composition of this Valve, is in clear Water, and by a particular Section, while the Intestine is fresh, and has not been altered by any Disease.

The remaining Portion, which forms the two Convolutions, in Form of the Roman S, contracts below the left Kidney ; being narrower there, than lower down. The Tunics of this Portion become gradually thicker and stronger, and likewise the ligamentary Membranes, which approach each other by degrees, and seem to increase in Breadth.

The Vessels, Nerves, &c. will be found in the Description of the Mesentery.

Of the RECTUM. The last of all the Intestines is named Rectum, from its Situation : For, when viewed directly forward, it appears to run down in a strait Course from the last lumbar Vertebra, on the anterior Side of the Os Sacrum, all the Way to the Os Coccygis, where it ends in what is called the Anus.

This Intestine, properly speaking, is but a true Continuation of the last Convolution of the Colon; and it is the Repository, or common Sewer, of the whole intestinal Canal. It has, likewise, a special Connection with the Bladder, and the Parts of Generation, in both Sexes.

The Rectum, after passing below the last lumbar Vertebra to the internal Surface of the Os Sacrum, is bent posteriorly on that concave Side to which it is connected ; and, having reached the Os Coccygis, it runs, likewise, in the Direction of that Bone, and bends a little anteriorly, terminating beyond the Extremity of the Coccyx.

The Figure of this Intestine varies, according as it is full or empty. When empty, it is irregularly cylindrical, and sinks in, by a kind of transverse Folds, and, in that State, it is about three Fingers Breadth in Diameter : When full, it is wider, in Proportion to the Quantity of Fæces, Wind, or whatever else is contained in it ; and may be extended, sometimes, to a very great Size.

The membranous Tunic often contains a great Quantity of Fat, spread between it and the muscular, and forming round the Intestine numerous Eminences, in lieu of the Appendices Adiposæ of the Colon, which has been explained in the History of the Omentum.

The muscular or fleshy Tunic is very thick. The longitudinal Fibres, which in the other Intestines are very thin, are, in this, stronger than the circular Fibres of the rest; the ligamentary Membranes continue to increase in Breadth, and approach each other, as has been said; and it is to the fleshy Fibres of these Membranes that the Thickness of the longitudinal Fibres seems to be owing.

The nervous or filamentary and internal Tunics are larger here than in the other Intestines; and, when the Rectum is empty, they form a great Number of waving Rugæ in its Cavity, which disappear, in Proportion as that Cavity is filled up.

The interior Tunic is very improperly termed Villosa, and scarcely deserves the Name of Papillaris, because of the Smallness of the Corpuscles spread on its Surface. It contains a great Number of single or solitary Glands; and it is always moistened by a Mucus of different Consistencies, discharged by these Glands or Folliculi, and perhaps by the Corpuscles also.

Near the Extremity of this Intestine, the Rugæ or Folds become, in a Manner, longitudinal; and at last, towards the Circumference of the interior Margin of the Anus, they form little Bags, or semilunar Lacunæ, the Openings of which are turned superiorly towards the Cavity of the Intestine: These Lacunæ are somewhat like those at the inferior Extremity of the Oesophagus, or superior Orifice of the Stomach.

MUSCLES of the ANUS. At length the Extremity of the Rectum contracts and terminates by a narrow Orifice, called the Anus, the Sides of which are disposed in close Folds, or Gathers.

The Extremity of this Intestine has several Muscles belonging to it; some of which surround it like Sphincters; the rest are broad fleshy Laminæ inserted into it; which, being likewise fixed to other Parts, sustain it in its natural Situation, and restore it to that Situation when disturbed by the Force necessary for the Expulsion of the Fæces. These latter Muscles are termed Levatores Ani; the first go by the general Name of Sphincters.

These Sphincters are three in Number: One intestinal, or orbicular; and two cutaneous, or oval; one of which is large, superior, and internal; the other small, inferior, and external.

The intestinal or orbicular Sphincter of the Anus consists merely in an Augmentation of the inferior Portion of the fleshy Fibres of the Extremity of the Rectum.

There are two Ligaments which it is proper to describe here; viz. the Ligamentum Cutaneum Ossis Coccygis, and the Ligamentum Pubis Interosseum.

The cutaneous Ligament goes out anteriorly from the Extremity of the Os Coccygis. It is very slender, and divides into two Portions at the Orifice of the Anus, which run into the Membrana Adiposa, and are inserted in the Skin, on each Side of the Anus, by a kind of Expansion; and, continuing to divaricate, they are lost on the two Sides of the Peritonæum.

The interosseous Ligament of the Ossa Pubis is a very strong triangular Membrane, fixed, by its two Extremities, to the inferior Rami of these Bones, all the Way up to their common Symphysis. The third Extremity, which is the inferior
one,

one, is loose ; and this whole Membrane, the Middle of which is perforated by a particular Foramen, is stretched very tight between the two Bones, and under their cartilaginous Arch, to which it adheres very closely.

At the inferior Part of this interosseous Ligament, along its whole inferior or loose Extremity, lies a digastric Muscle*, fixed, by its two Ends, in the Rami of the Offa Pubis ; its middle Tendon lying on the Middle of the Extremity of the Ligament.

The cutaneous Sphincters have each an anterior and posterior Insertion, ending both Ways in a kind of Point, and comprehending the Orifice of the Anus between their middle Portions.

They are distinguished from each other by their Situation, Size, and a kind of white cellular Line. The greatest of the two appears to be double, and the smallest lies nearest the Skin, and adheres closely to it.

They are inserted, posteriorly, partly in the Apex of the Os Coccygis, and partly in the contiguous Portion of the cutaneous Ligament of that Bone ; anteriorly, their chief Insertion is in the middle Tendon of the Transversalis Urethræ ; and they have likewise some Connections to other Muscles of the Urethra.

The Levatores Ani are broad, thin, muscular Portions, fixed, by one Extremity of their fleshy Fibres, round the concave Side of the inferior Portion of the Pelvis, from the Symphysis of the Offa Pubis beyond the Spine of the Iſchium. The other Extremity of these Fibres runs down on each

* The Description of that Muscle does not belong to this Place ; and is mentioned here, only because of the Relation it bears to the cutaneous Sphincters of the Anus. It is called, by some, *Musculus Transversalis Urethræ* ; by others, *Musculus Triangularis*.

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Side behind, and under the Curvature of the End of the Rectum, where they meet together, and unite, from the Basis of the Os Coccygis, all the Way to the Margin of the Anus.

By their superior Insertions these Portions are, on each Side of the Pelvis, divided into three Classes; an anterior, middle, and posterior Class.

The two anterior Classes reach from about the Middle of the Symphysis of the *Ossa Pubis* to the superior Border of the *Foramina Ovalia* of the Pelvis; the middle Classes continue the same Course immediately above the Insertion of the *Obturator Internus*, on the *Ossa Ischium*, and a little on the *Ossa Ileum*: The posterior Classes are spread on the interior Sides of the *Ossa Ischium* to the spinal Apophyses of these Bones, and even a little beyond these, on the *Ligamenta Sacro-Sciatica*.

The anterior Portions are, in their Passage, connected to the prostrate Glands, to the Neck of the Bladder, and to the Bulb of the Urethra; as shall be demonstrated, in the Description of those Parts: And they sometimes send Fibres to the *Musculus Transversalis Urethræ* above mentioned.

The Fibres of all these Portions, having, by their superior Insertions, formed this ample Circumference, run down obliquely from the anterior to the posterior, contracting in Breadth, and approaching each other in manner of truncated Radii; and behind, and under the Extremity of the Rectum, they form a digastric Muscle, somewhat like the *Mylo-Hyoïdæus*; which terminates the Pelvis, and forms the inferior Cavity of the Abdomen, as the Diaphragm does that of the superior.

It is proper here to observe, that the Muscles of the Os Coccygis may be looked upon as Assistants to the Levatores.

We

We ought likewise to remark, that the Margin of the Anus is by the Union of the Cutis and Epidermis.

OBSERVATIONS.

The inferior End of the Rectum is the Seat of the true Fistula in Ano, which usually runs between the muscular Coat and the interior one. It is cured by opening it, the whole Length, into the Cavity of the Gut: It is yet better, if it can be done, to extirpate all that is fistulous and schirrous; for that is a sure Way to make one Operation perfect the Cure.

The other Kind of Fistula, improperly so called, is an Abscess running round the Outside of the Sphincter, in the Shape of an Horse-shoe, being a perfect Circle, except at the Place where this Muscle unites with those of the Penis. This is best cured by opening and removing Part of the outer Skin. The first of these Cases happens oftenest in full Habits, proceeding frequently from the Piles; the last is generally a critical Discharge, and one of Nature's last Efforts in consumptive and scorbutic Habits of Body. The Inversion and sliding down of this Gut is called Prolapsus Ani, a Disease common in Children, especially those who are afflicted with the Stone, and of not much Consequence. In Men it is more rare, and more dangerous; being generally attended with a Flux of Humours. This Case I have cured, by taking away a Piece of the prolapsed Gut with a Caustic, lengthways of the Gut. The Wound discharged the Flux of Humours; upon which the Gut was easily reduced; and cicatrizing, in that State, it never more fell down.

I have seen a Case, where a bold unthinking Surgeon having cut off the prolapsed Part, the Cicatrix was so hard and contracted, that the Patient

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tient could never after go to Stool without a Clyster, and then not without great Misery.

Oftentimes the Piles occasion large Tumors at the lower End of this Gut. These are always best extirpated by Ligature: For if they are cut, they will sometimes bleed excessively; and it is not an easy Matter to apply any Thing to stop a Flux of Blood in that Part. CHESELDEN's * Anatomy.

A Woman, in the fiftieth Year of her Age, had a Rupture at her Navel, which continued till the seventy-third Year; when, after a Fit of the Cholic, it mortified: And she being presently after taken with a Vomiting, it burst. I went to her, and found her in this Condition, with about Twenty-six Inches and a Half of the Hanging-out mortified. I took away what was mortified, and left the End of the sound Gut hanging out at the Navel, to which it afterwards adhered. She recovered, and lived many Years after; voiding the Excrements through the Intestine at the Navel. And though the Ulcer was so large, after the Mortification separated, that the Breadth of two Guts was seen; yet she never, at any Time, protruded out at the Wound, though she was taken out of her Bed, and sat up every Day. Ibid.

Disorders the INTESTINES are most subject to.

The Intestines, especially the small ones, are subject to acute Inflammations in their Membranes. This Disorder happens by the common Causes of an Inflammation conveyed to them: Either (for instance) by the acrid Substance of Liquors, Aliments, Spices, Pickles, Medicines, or

* If I did not know that Mr. CHESELDEN had been a Surgeon, I should have thought that this had been the Language of a Butcher, rather than that of an Anatomist.

Poisons, received from the Stomach, and conveyed from thence to the intestinal Valvules. This Disease may also be produced by an acrid, putrid, foetid, purulent, ichorous, gangrenous, bilious Matter, &c. conveyed from the Oesophagus, Stomach, Liver, Spleen, Pancreas, and Omentum, to the Intestines; where it remains, and corrodes them. And, lastly, an intestinal Inflammation may be caused by violent previous Convulsions; which create Flatulencies, and stop the Motion of the Fluids; which cause an Inflammation. This Disorder contracts the Intestines, closes up their Cavities, and obstructs the Passage of what should be conveyed to them. Thence arise acute, burning, and fixed Pains; excites violent Convulsions, when the inflamed Part is irritated by what is conveyed to it; renders the Patient costive, excites Vomiting, if the intestinal Portion is inflamed near the Pylorus, or by the inferior Portion of the Intestines; causes painful Flatulencies, acute Gripes accompanied with Rumblings, the Iliac Passion, the Disease called Volvulus, an Abscess, Gangrene, Scirrus, Cancer, vehement acute Fever, excessive Weakness, and, oftentimes, sudden Death.

As long as the Disorder continues in its inflammatory State, it is, by ignorant and unskilful Persons, taken for what the Vulgar call the Twisting of the Guts, which they ascribe to cold Flatulencies, and therefore prescribe hot Medicines; a Practice which often proves fatal to the Patient*.

But a genuine Inflammation of the Intestines is known by its concomitant, continual, acute
Fever,

* An Instance of this I saw last Winter, when I was desired to open the Body of a Male Child about seven Months old, who, for some Time, could not keep any Thing in his Stomach, nor would
any

Fever, intense Thirst, excessive Heat, a hard Pulse, a burning Pain, high-coloured Urine, and the Induction of a sudden Weakness.

When an Inflammation seizes the Flexure of the Colon, the Disorder is termed the Colic; but if seizes the Extremity of the Rectum, it is generally taken for the Blind Hæmorrhoids: In which Case, its most happy Termination is by a mild, bloody, and bilious Dysentery.

As soon as we suspect an intestinal Inflammation, in its first Stage, we should order Venesection pretty freely, as in a Pleurisy; then antiphlogistic Clysters, repeated three or four Times a Day, or oftener; drinking, frequently, laxative diluting Liquors.

From what has been observed, it is sufficiently obvious, why, in Practice, such violent, fixed, obstinate, intolerable, and unsurmountable Pains are perceived in the Oesophagus, the Orifice of the Stomach, the Liver, Spleen, Pancreas, Ileum, and the Colon; as also, how various and surprising a Disorder a Dysentery is, in every Respect! How improperly and unjustly, in Diseases of this Kind, a certain hectic Acrimony of Humours is accused, and prejudicial Medicines exhibited, in order to remove this supposed Acrimony? How cautious one ought to be, in exhibiting Purgatives, in excessive Pains of these Parts! What is the Nature of that

any Thing pass through his Intestines, notwithstanding all proper Medicines were administered. On examining the Intestines, I found that Part of the Colon, which lies under the Stomach, bent down quite across the Duodenum, and the Cæcum, with a Portion of the Ileum, intromitted about nine Inches into the Colon; which I, with some Difficulty, disinvolved; and found that Part of the Ileum, which opens into the Cæcum, callous, and almost mortified: A fuller Account of which, I have given to the ROYAL SOCIETY, at the same Time that I shewed the Intestines, which I preserved: It being the most extraordinary Case, of this Kind, that ever was met with.

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incurable Hypercatharsis, which, in some Patients, frequently succeeds the Administration of Purgatives! How various are the Remedies and Measures which are requisite for the Cure of Dysenteries! How vain, fallacious, and destructive, it is to prescribe one Medicine as proper in all their various Conditions and Natures! Or, in short, a general Method of Cure. See BOERHAAVE's Aphorism.

N. B. I do not take Notice here, of the Worms which the Intestines are very much subject to, especially in young Subjects.





LECTURE IV.

Of the MESENTERIUM, MESOCOLON,
SANGUIFEROUS VESSELS, and NERVES,
of the INTESTINES.

THE Intestines are connected by a membranous Lamina, which prevents the intestinal Convolutions from being intangled with each other, and twisted or compressed, in all their different Ways of collecting; and yet have a gentle floating, but limited Motion, in their natural State.

This membranous Lamina is named, by the Ancients, Mesentery, as being, in some measure, in the Middle of the Intestines.

It is divided into two Portions; one of which, being very broad, and very much plaited, connects the small Intestines; the other, which is long and incurvated, does the same Office to the great Intestines.

These two Portions are, in Reality, only one and the same Continuation of the membranous Lamina of the Duplicature of the Peritonæum; and they are distinguished only by their Breadth.

Taken both together, they form a kind of spiral Roll, more or less plaited in its Circumference. The first Portion has retained the Name of Mesentery; the other is termed Mesocolon.

66 Of the Mesenterium, &c. Lect. iv.

Structure of the MESENTERY, &c.

The Mesentery begins at the last Incurvation of the Duodenum, and runs obliquely, from left to right, along the lumbar Vertebrae: In this Space, the membranous Portion of the Peritonæum produces a Duplication by two Elongations, or particular Laminæ, applied to each other; and thus forms the Mesentery.

It is narrow at its superior and inferior Parts, but chiefly at the superior; the middle Portion is very broad, and the Edge of it next to the Intestines is every-where very much plaited. The Plaits, or Folds, are only waving Inflections, such as may be observed on the Edge of a Piece of Shamoy, which has often been drawn through the Fingers. They make this Edge of the Mesentery very long, and run through about a third Part of its Breadth.

The two Laminæ are connected by a cellular Substance, which invests the Glands, Vessels, and Nerves; and, in some Subjects, it has a great Quantity of Fat, which keeps the two Laminæ at some Distance from each other.

Along the whole Circumference of the Mesentery the two Laminæ are naturally separated, to involute the Circumference of the small Intestines, which they invest by their Union, or rather reciprocal Continuation on the great Curvature of that Canal, and carry it as in a Scarf or Sling. This is what forms the external or membranous Tunic of the Intestines.

The Mesocolon is the Continuation of the Mesentery; which, having reached the Extremity of the Ileum, contracts, and assumes this Name. At this Place the particular Lamina, which is turned to the right Side, forms a small transverse Fold, called Ligamentum Coli Dextrum.

After-

Lect. iv. Of the Mesenterium, &c. 67

Afterwards the Mesocolon ascends towards the right Kidney, where it seems to be lost by the immediate Adhesion of the Colon to that Kidney, and to the first Incurvation of the Duodenum; then it appears again, and, increasing in Breadth, continues its Course almost transversely under the Liver, Stomach, and Spleen, where it begins to turn downwards under the left Hypochondrium, towards the Kidney on the same Side.

Through this whole Course, the Mesocolon extends in Breadth, and forms nearly a transverse semicircular Plane, very little plaited at its great Circumference: By this Circumference, or Edge, it is connected to the Colon, and hides that ligamentary Membrane of this Intestine which runs along its small Curvature.

By its short or small Edge it forms the triangular Case of the Duodenum; and, by its great Edge, the external Tunic of the Colon, in the same Manner as the Mesentery does that of the small Intestines.

As it passes under the great Extremity of the Stomach, it adheres a little to the inferior Portion of that Extremity, as the Diaphragm does to the superior: Having got below the left Kidney, it contracts, and forms another transverse Fold called Ligamentum Coli Sinistrum; afterwards it expands again, but not so much as in the superior Part, and runs down, on the left Psoas Muscle, towards the last lumbar Vertebra: This descending Portion is fixed to the Convolutions of the Colon, in the same Manner as the superior Portion is to the Arch of that Intestine.

The Intestinum Rectum is likewise invested by a particular Production of the Peritonæum, commonly called by the barbarous Name of Mesorectum: This Production is very narrow; and about the Middle of the anterior Side of the

68 Of the Mesenterium, &c. Lect. iv.

Rectum, it forms a transverse semicircular Fold, which appears when the Intestine is empty, but is lost when it is filled.

SANGUIFEROUS VESSELS of the INTESTINES.

The Duodenum has commonly a particular Artery, called Duodenalis, or Intestinalis, which comes indifferently from the Stomachica Coronaria, Pylorica, Gastrica Major, or Hepatica: It has likewise several distinct Ramifications from these Trunks, and from the Mesenterica Superior and Splenica; which Ramifications communicate with each other.

The Arteria Duodenalis, and the other additional small Arteries, form a vascular Texture round the muscular Coat of the Intestine, which sends out a great Number of Capillaries both towards the exterior and interior Sides, which make the whole Intestine look of a red Colour.

The Veins of the Duodenum are Rami of the Vena Porta; and the Distribution and Denomination thereof is pretty much the same with that of the Arteries; only they communicate more with each other than the Arteries, and also with the great Hæmorrhoidal Vein.

The venal Ramifications form, round the Duodenum, a reticular Texture, like that of the Arteries; and the same kind of vascular Texture is more or less to be found on all the other Intestines.

The Arteries of the Jejunum come chiefly from the Mesenterica Superior, and some from the ascending Branch of the Mesenterica Inferior: The Veins are, for the most part, Branches of the Mesaraica Major, and the rest come from the Splenica and Mesaraica Minor, or Hæmorrhoidalis Interna.

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The principal subaltern Trunks of these Arteries and Veins accompany each other through the cellular Substance, between the Laminæ of the Mesentery; are distributed by Branches or Rami, and form the Meshes, Lozenges, and Arches, mentioned in the Description of the Arteries and Veins: The last of these Arteries and Lozenges, or those next to the Intestine, produce two small vascular Laminæ, which separate from each other very distinctly, and surround the intestinal Canal like a Net.

The Blood-Vessels of the Ileum come from the same Source with those of the Jejunum, as has been said in the History of the Arteries and Veins: And it ought to be observed, concerning both these Vessels and those of the Jejunum, that, in their whole Course through the Mesentery, they give Ramifications to the Glands, Laminæ, and cellular Substance of the Mesentery; and also, that there is a kind of Communication between several small mesaraic Veins and the capillary Rami of the Venæ Lumbares and Spermaticæ.

The Arteries of the Cæcum and Appendicula Vermiformis are Ramifications of the last Branch, from the convex Side of the Mesenterica Superior; and they have likewise some small ones* from the second and third Rami, when both are found. The Veins of these two Parts are Ramifications of the Mesaraica Major; and one of these Rami is, by RIOLAN, termed Vena Cæcalis.

The streight Portion of the Arch of the Colon, or that which is an immediate Continuation of the Cæcum, is supplied with Arteries by the second Branch, which comes from the concave Side of the Mesenterica Superior; and likewise a little by the third, when there is a third.

The superior or middle Portion of the Arch of the Colon is furnished, by the first Branch, from

70 Of the Mesenterium, &c. Lect. iv.

the same Side of the Mesenterica Superior, which, by a Bifurcation, communicates on both Hands with the other Portions of the Arch of the Colon.

The left Portion of this Arch derives its Arteries partly from the first Branch of the same Mesenterica, and partly from that of the Mesenterica Inferior; which two Branches form the celebrated Communication, or common Arch of the two Mesentericæ.

By means of this Communication, or Continuation, in case one Artery should be obstructed or compressed, the other will furnish Blood to all the Branches below the Place of the Obstruction. The second Branch of the Mesenterica Inferior gives likewise small Arteries to the left Extremity of the Colon. The descending Convolutions of the Colon, which represent a Roman S, are supplied by the other Branches of the Mesenterica Inferior, the last of which forms the Hæmorrhoidalis Interna.

The Veins of all these Portions of the Colon are Branches and Ramifications of the Vena Portæ Ventralis, and principally of the subaltern Trunks, the Mesaraica Major and Mesaraica Minor, or Hæmorrhoidalis Interna. The Distribution of these Branches and Ramifications is, in some measure, the same with that of the Arteries; as may be seen in the Description of the Veins.

The Arteries of the Rectum are furnished by the Hæmorrhoidalis Interna, the last Branch of the Mesenterica Inferior, which communicates with the Hypogastrica, and particularly with the Hæmorrhoidalis Externa, a Production of one of these Arteries.

The Veins of the Rectum are Ramifications of the last Branches of the Mesaraica Minor, or Hæmorrhoidalis Interna; and they communicate with the Hæmorrhoidales Externæ, which are Rami of

LECT. IV. Of the Mesenterium, &c. 71

one of the Hypogastricæ: They communicate, likewise, with the capillary Ramifications of the other Hypogastric Veins, which go to the internal Parts of Generation of both Sexes.

It is here to be observed in general, that there is a successive Continuation, more or less simple or multiplied, between all the Arteries of the Intestinal Canal, and likewise between all the Veins; and also, that the Veins are here thinner and more capacious than the Arteries, in a greater Proportion than in the other Parts of the Body.

NERVES of the INTESTINES.

The Nerves of the Duodenum are, the middle Plexus of the semilunar Ganglion, and some Filaments of the Plexus Stomachicus and Hepaticus.

The Nerves of the Jejunum, Ileum, and mesenteric Glands, are, the Plexus Mesentericus Superior, the posterior Mesenteric Fasciculi, and the Plexus Mesentericus Inferior.

The Nerves of the Cæcum are, the posterior Mesenteric Fasciculi, or Plexus, and the Plexus Mesentericus Inferior.

The Nerves of the Arch of the Colon are, the same Fasciculi, and the two Plexus Mesenterici.

The Nerves of the last Convolutions of the Colon are, the posterior Mesenteric Fasciculi, and the Plexus Mesentericus Inferior, and Sub-Mesentericus.

The Nerves of the Rectum are, the Plexus Mesentericus Inferior, Plexus Sub-Mesentericus, or Hypogastricus, and the two Ganglions of that Plexus.

The Nerves of the Anus, and of its Muscles, are, the Ganglions of the Plexus Sub-Mesentericus, the inferior Rope of both the Sympathetici Maximi,

72 Of the Mesenterium, &c. Lect. IV. imi, and the common Arch of the Extremities of both Branches.

THE MESENTERIC GLANDS, LYMPHATIC and LACTEAL VESSELS.

Between the Laminæ of the Mesentery, a great Number of Glands lies scattered through the cellular Substance. In the natural State these Glands are somewhat of the Figure of Lentils, or little round Beans; some of them being orbicular, others oval, but all of them a little flattened; and in corpulent Subjects we find them surrounded with Fat.

These Glands are of the Number of those which Anatomists call *Glandulæ Conglobatæ*, the Structure of which is not, as yet, sufficiently known. They seem to be of a cellular Substance, surrounded by a very fine Membrane, or Tunic; on which, by the Help of a Microscope, may be seen an Intertexture of particular Filaments, which MALPIGHI believed to be fleshy Fibres.

The nicest anatomical Injections have not hitherto given us any Satisfaction about these Particulars: For though they are made with all possible Care, they always fill the folliculous Texture of these Glands. And though, by means of these Injections, we may discover a great many Vessels, which were before invisible; we are not a whit the nearer in our Purpose; because we cannot, by this Method, distinguish the secretory, excretory, and sanguiferous Vessels, from each other.

LYMPHATIC VESSELS.

Besides the sanguiferous Vessels, which are distributed, in a reticular Manner, in the mesenteric Glands, and besides many nervous Filaments spread
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Lect. IV. Of the Mesenterium, &c. 73

through them; we discover an infinite Number of small Vessels, of another Kind, running from Gland to Gland.

These Vessels are extremely thin, and transparent; and furnished on the Inside with numerous Valves, which appear on the external like little small Knots, very near each other. They emerge from each Gland, by Ramifications, as by so many Roots; and, having formed a small Trunk, they are again divided, and enter some adjacent Gland, by the same kind of Ramifications which they went out from the former.

They are termed lymphatic Vessels, because, for the most part, they contain a very limpid, though mucilaginous Serum, called Lympha by Anatomists.

But as they have likewise been observed to be filled with a milky Fluid called Chyle, they have been called Vasa Chylifera, or Venæ Lactææ. They have the Name of Veins, because their Valves are disposed like those of the sanguiferous, and because the Fluid, which they contain, runs from smaller into larger Tubes.

Division of the LACTEAL VESSELS.

Dr. WINSLOW commonly divided the lacteal Vessels of the human Body into three Classes; but sometimes into four.

They derive their Origin from the Tunica Villosa of the Intestines, and chiefly from that of the small Intestines, by a great Number of capillary Roots, as has been already said.

From these Roots there arises, between the Tunica of the Intestines, a kind of Rete Mirabile, which surrounds almost the whole Circumference of the intestinal Canal between the muscular and external Tunica.

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74 Of the Mesenterium, &c. Lect. IV.

This reticular Texture of the lacteal Vessels, keeps close to the external Tunic, and leaves the Canal, along with it, on the Side of the Mesentery, where it forms two Planes of Ramifications, plainly distinguished from each other by the cellular Substance, and adhering closely to the Inside of the two Membranes of the Mesentery. In this separate State they run on the Laminæ of the Mesentery, as far as the first mesenteric Glands, where they unite again in one Plane. All this is reckoned the first Class of Lacteals.

The second. After this Union, the lacteal Vessels are distributed almost uniformly, through the whole Extent of the Mesentery, from its Circumference to its Origin, or Adhesion to the dorsal Vertebrae, between the mesenteric Glands, which they join, in the Manner already said, and form frequent Anastomoses, or Communications.

Having passed through the Mesentery, in this Manner, the Ramifications begin to unite, as they approach the Spina Dorsi, and consequently their Number is lessened, and their Size increased; and, having passed the last mesenteric Glands, they terminate about the Middle of the Adhesion of the Mesocolon, in small common Trunks, which receive a great Number of lymphatic Vessels from the Glandulæ Lumbares, and others below these.

A fourth Class may be made of the lacteal Vessels of the great Intestines; of which several, full of Chyle, have been demonstrated to the ROYAL ACADEMY at Paris, in a human Colon.

The lacteal Vessels are not always apparent in human Subjects; but we may see them in those who die either a violent or sudden Death, soon after a Meal; and they remain visible, even in the Intestines, for a long Time after Death, when a
great

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great Number of the mesenteric Glands have become scirrous, especially in Children, and those who die of scrophulous Disorders.

RECEPTACULUM CHYLI.

The lacteal Vessels of the third Class, or those which lie between the mesenteric Glands and middle Adhesion of the Mesocolon to the Spina Dorfi, run down on the Body of the inferior Aorta, between the Extremities of the small Muscle of the Diaphragm, and terminate in a kind of Cistern, called, by some, Receptaculum Chyli, by others, Receptaculum Pecqueti; from PECQUET, a Physician at Dieppe; who first demonstrated, by incontestable Experiments, in the Year 1651, this Receptacle; which had been, long before, discovered by EUSTACHIUS*.

The Thoracic Duct, so named from its Course, is generally single; or if it be double, for some Part of its Course, it soon after unites into one again, which goes behind the Pleura; ascending in an inflected Course, it receives, in its Way, the lymphatic Vessels of the Stomach, Oesophagus, and Lungs; and passes through the dorsal Glands, of the many which are incumbent on and about it. It is generally cylindrical, and often forms Infulation, by dividing into two, or more; after which it unites into one again, especially in its superior Part. It has but a few Valves, which are not very conspicuous.

* Itaque in illis animantibus (Scel. Equis) ab hoc ipso in signi trunco sinistro Juguli, qua posterior sedes radicis Vena Jugularis spectat, magna quædam propago germinat, quæ præterquam quod in ejus origine Osteolum semicirculare habet, est etiam alba & aquei Humoris plena; nec longe ab ortu in duas partes scinditur, paulo post rursus coeuntes in unam, quæ nullos ramos diffundens, juxta sinistrum Vertebrarum latus, quo loco latior effecta, magnæque Arteriam circumplan, obscurissimum finem, mihi que non bene perceptum, obtinet. Vid. De Vena sine pari.

76 Of the Mesenterium, &c. Lect. iv.

About the fifth dorsal Vertebra it generally crosses behind the Oesophagus, and then ascends along the right Side of the Thorax, behind the subclavian Veins, till it has arrived near the fix cervical Vertebrae: There, bending down, it often divides into two, and each descending Branch dilates into a Sort of Vesicle which enters, either with distinct or united Openings, into the Junction of the Subclavian and Jugular Vein internally, by an oblique Course, from the superior, posterior, and lateral Part, inferiorly towards the left and anterior; advancing, either with one or two Branches, under the Subclavian, on the exterior Side of its Junction with the Jugular. It has no true Valve placed before it, but excludes the Entrance of the Blood, only the perpendicular Weight of its Contents; but the oblique Insertion of it represents a sort of Wrinkle. It is rarely otherways disposed, and very seldom split in two, longitudinally, for distinct Insertions into the Subclavian; and yet more uncommonly apt to send off a Branch into the Vena Azygos. Near its Insertion it receives the Opening of a large lymphatic Vessel transversely from the Arm, and others descending from the Head, in one or more Trunks.

The Function of the INTESTINES.

From the exhaling Arteries distils a thin aqueous Liquor into the Cavity of the Intestine, not at all acid, but like the stomachic Juice; the Quantity of which may be computed from the large Extent or Number of the excretory Orifices, and from the Section of the excretory Artery, larger than which we see elsewhere of the Body: Add to this, the Laxity of the Parts, perpetually kept warm and moist, and the copious Diarrhœa or watery Discharge which often follows the Use of Cathartics. But that the Mucus arising from the Pores
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or Cells of the Intestines serves to lubricate and defend the internal Surface of the villous Membrane, and to preserve the Nerves from the Vehemency of too acrid or pungent Particles.

Hence we see, that it is more copious at the Beginning of the larger Intestines; because there the Mass of Aliment begins to be more feculent, acrid, and tenacious.

The Mixture of this Liquor with the Pulp-like Mass of the Aliment, together with the Bile and pancreatic Juice, is made by the Motion of the surrounding Muscles of the Abdomen, but more especially by the peristaltic Motion, which is more particularly strong and obvious in the small Intestines. For any Part of the Intestines, irritated by Flatus, or any sharp Humour, contracts itself, even after Death, with a considerable Force: This contracting Motion is made in various Parts of the Intestines, either successively, or at the same Time, wherever the Flatus or Aliment excite a Stimulus; and this, without observing any certain Order, with a Sort of wonderful alternate Creeping and Revolution of the Intestines, as appears easily in dissecting living Animals, and sometimes, by unhappy Accidents, in the human Species: As in Ruptures, Wounds of the Abdomen, &c. (this Creeping of the Intestines, for the Facility and Duration, is equal, if not superior, to the Irritability of the Heart itself.) Among so many Inflections, the Weight of the Aliment is but of little Force: It easily ascends or descends through the irritated Intestine, which thus empties itself. From whence the Use of the peristaltic Motion is intelligible, by which the Pulp of the alimentary Substance is oftener or longer applied, with a gentle Force, to the Triture of the Intestine, to the exhaling diluent Liquor, and to the Orifices of the absorbing Vessels. But all the Contents of
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78 Of the Mesenterium, &c. Lect. IV.

the Intestines are determined downwards to the Colon; because the Stimulus begins above, from the inferior Orifice of the Stomach; and, by the Succession of new Chyle repeating it above the Contraction, it descends, when there is no Resistance made to it, into the inferior Part of the Ileum, at its Opening into the Colon: Therein the loose Part of this Intestine readily receives what is pressed into it by the Contraction from above, and as easily exonerates itself into a large unactive Cæcum; from whence it is again repelled upwards, and, in Part, urged on by the Pressure of the succeeding Aliments. Some Persons observe, that this Motion is stronger in the inferior than the superior Part.

The intestinal Fæces, therefore, retained in the Bottom of the Cæcum, grow dry there by the Absorption of moist Vapours, so as to be capable of receiving a Figure from the round contracted Parts of the Colon; by which being sustained, as on a Stair-case, they ascend from the Cæcum, elevated by the long Ligaments, which end in the Vermiformis.

Here we more easily perceive the Manner in which the Fæces are propelled by the muscular Contractions of the circular Fibres, whose Contractions are less conspicuous in the small Intestines. The longitudinal Fibres of the Intestine being attached to the contracted Parts, as fixed Points, draw up and dilate the inferior Parts of the Intestine; then the next intestinal Portions, to which the Fæces are brought, being irritated, and contracted, in like manner, are, immediately after, drawn together by the circular longitudinal Fibres, by a successive Repetition, till the Fæces have intirely passed through the large Intestine. This peristaltic Motion is very conspicuous in Wounds of the Abdomen, and is ocularly demonstrable in the comparative Anatomy of Brutes.

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Whilst the Fæces or Excrements ascend, by means of the Rugæ or Valves of the Ileum, the Gravity of them depresses the inferior Valve to the left Side, which draws back the Ligament, common to each Valve, in such a Manner, as to compress and exactly close up the superior Valve inferiorly, that nothing may go back into the Ileum, which might easily happen in a fluid State of the Fæces: From thence they continue the progressive Motion slowly through the whole Track, and repeated Flexures of the Colon, so as to retain the Excrements; till, at length, the Excrements arrive at the Rectum, which is inflected first a little posteriorly, and then anteriorly, into a broad depressed Figure, at first descending contiguous to, and afterwards spread under the Bladder in Men, or Vagina in Women, but contracted more in the former than the latter: Therefore, whenever the Fæces are collected to a considerable Quantity in the Rectum, so as to become troublesome, either by their Weight, Irritation, or Acrimony, which excite an Uneasiness through the adjacent Viscera, and are then urged down to the Anus, by a voluntary Pressure, and the Force of the incumbent Diaphragm: For, by this Means, the abdominal Viscera, when the Resistance of the Anus is overcome, the compressing Forces of the Diaphragm abate, and the Fæces continue to discharge from the Body, urged only by the peristaltic Motion itself. After the Excrements are expelled, the Intestine is drawn back or up again, into its natural Situation, by means of its longitudinal muscular Fibres; after which, the Opening of the Anus itself is closely contracted by the sphincter Muscles, as before.



LECTURE V.

Of HUNGER, THIRST, FOOD, and DRINK.

WE see that the Creator has given to Man the two faithful Guards of Pleasure and Pain for his Preservation; one to avert Evil, the other to invite him to useful Actions. From hence we are informed, that the taking of Aliments is an Action necessary and useful to our Support.

For since every Day there is a great Quantity wasted from the Body, by a Dissolution of its true Substance, thrown off by Perspiration, and other Discharges; a Reparation of the said Loss is absolutely necessary: And this is more especially demanded from the Aliment, by the Nature of the Blood itself, strongly inclined to a sharp, saline, lixivial Quality; and to a putrid acrimonious State, to which it is continually sollicitated, and approaches from the putrescent Disposition of all the more stagnant Humours of the Animal, promoted by the incessant and natural Motion of the Heart and Arteries, with a perpetual Heat. Moreover, the Disposition of the Blood to be coagulated, continually losing a great Part of its diluting Water, by insensible Perspiration, calls strenuously for a Recruit of the watery Element, in the Way of Drink, by which its cohesive Globules are separated from each other, and hindered from running together into a consistent Mass.

These

Lect. v. Of Hunger, Thirst, &c. 81

These Truths are proved not only from their Causes, but likewise by the Effects and Appearances which they exhibit in Men, and other Animals, killed by Hunger: For, in these, we commonly observe a sharp stinking Breath, a Looseness of the Teeth, from the dissolving Acrimony of the Juices; violent Pains in the Stomach, a sharp Fever, and even a true Madness. All these Disorders arise sooner and stronger, as the Person is more robust, and more violently exercised with Motion of Body; but they ensue very slowly in phlegmatic People, who are inactive, perspire little, and put the Blood into no great Motion.

The fresh Chyle, composed, for the most part, out of the acescent Class of Vegetables, and of a Consistence always thinner than that of the Blood itself, being received into its Torrent of Circulation, serves to temperate the putrescent Acrimony, to dilute or lessen the Coagulation threatened, and reduce the whole Mass from a sharp saline, to the mild albuminous Nature, which is proper to healthy Blood: And, finally, the Chyle, but more especially that derived from the Flesh of Animals, being replenished with gelatinous Lymph, serves to repair the Consumption, or Waste, which is made from the Body itself, to the Vacuities of whose broken Solids it is applied, by the Causes before mentioned. But the Drink chiefly dilutes the cohesive or grumous Inclination of the Blood, hinders its putrescent Acrimony, and carries off, by the Emunctories, such Particles as are already putrid; and hence it is, that a Person may live, for a long Time, without solid Food, if he be but supplied with Drink, or even Water.

We are solicited to take Food, as well from the Sense of Pain which we call Hunger, as from that of Pleasure, which is received by the Taste. The first of these proceeds, doubtless, from the sensible

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Folds or Wrinkles of the Stomach rubbing against each other, by the peristaltic Motion, joined with a Pressure from the Diaphragm and abdominal Muscles, by which the naked Villi of the Nerves on one Side grate against those of the other, after a Manner intolerable. Thus we are effectually admonished of the Dangers ensuing, from too long Abstinence or Fasting, and excited to procure Food or Nourishment by Labour and Industry. To this Sense, also, the gastric Liquor, or Juice of the Stomach, collected and sharpened after Feeding, does, in some measure, conduce.

Thirst is seated in the Tongue, Fauces, Oesophagus, and Stomach. For, whenever these very sensible Parts, which are constantly and naturally moistened, by mucous and salival Juices, grow dry, from a Deficiency of those or the like Humours, or are irritated by a Redundancy of muriatic or alcalescent Salts, here lodged, there arises a Sense much more intolerable than the former, as Thirst is more dangerous; whose uneasy Sense continues till the Proportion of diluting Water in the Blood, being recruited, restores the necessary Moisture, and free Secretion required in the Parts before mentioned.

From hence we learn, why Thirst attends Labour, which exhales a greater Proportion of the watery Perspiration; and why it is a Symptom of Fevers: Where there is a Driness and Obstruction of the exhaling Vessels belonging to the Tongue and Fauces; why simple Water, having no Tenacity, will often not stick long enough to the Juices to abate Thirst, which yields, nevertheless, easily to some acid Liquors, which not only moisten and render fluid, but also neutralize and provoke forward the Humours.

From these Causes, Mortals, being under a Necessity of seeking Food, for the Support of Life,
have,

have, from the Beginning of Ages, determined their Choice, to the succulent Parts of Vegetables and Animals, in such a Manner, that Water and Salt seem to be added only as third Assistants. And first, it is probable, that the primitive Choice of our Foods was made by Experiments, according as the Variety of Smells and Flavours in Vegetables, and their several Parts, invited, and as the Strength and Recruit of our Faculties, thence following, confirmed their Utility. But, by degrees, Animals increasing so much as to be incommodious to Man, now declining in his Constitution or Longevity, the Flesh of Animals was afterwards added, as a better Support for those Labours, which could not be so well sustained by vegetable Food alone.

At present, both the Number and Variety of Substances are almost infinite, which we take either as Food, or Seasoning, for our Nourishment.

Although there are many Instances of particular Persons, and even of whole Nations, who have supported Life only with one kind of Food, either vegetable or animal, or even from a small Class of either of them; and although some have lived altogether upon Milk, or its Whey; yet it seems to be necessary, both from the Nature and Fabric of the human Body itself, as well as from the known Effects which follow from only one Kind of Food, that we ought to support Life, by the two Kinds of Foods, both animal and vegetable, so intermixed, that neither of them may exceed their reasonable Bounds; and this Mediocrity we are taught from the Loathing itself, which follows to any one Kind of Food, that has been continued for too long a Time together.

The Flesh of Animals appears a necessary Part of our Nourishment, even from the Fabric of the human Stomach itself, resembling that of carni-

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vorous Animals; and from the two Rows of Teeth, with the canine Teeth in each Jaw; also from the Smalness and Shortness of the Intestinum Cæcum, and from the necessary Vigour which we require, which is more remarkable in carnivorous Animals.

For it appears, that the Flesh of Animals only contains the gelatinous Lymph, ready prepared for the Recruit both of our Fluids and Solids; which, being extracted from the broken Vessels and Fibres, is readily converted into abundance of Blood.

An Abstinence from animal Food, in those who have been accustomed to it, generally causes great Weakness, both to the Body and Stomach; being perpetually attended with a troublesome Diarrhæa, or Purging. (But in the Amplitude and Length of the Intestina Crassa, Man agrees with herbivorous Animals.)

Esculent Vegetables are generally of the acscent Kind, only some few of them are either alcalescent, or else replenished with a Spiciness; but none of them have that animal Glue which is spontaneously changeable into Blood: For it is only the small Portion of Jelly, which is drawn from their farinaceous Parts, which, after many repeated Circulations, is converted into the Nature of our indigenous Juices. Yet these are necessary to avoid Over-repletion with Blood, and of too putrescent a Kind, from the Use of animal Food alone, which, from the most creditable Accounts of the Anthropophagi, prevails to so great a Degree, as to breed the hot alcalescent Scurvy, a fierce or savage Temper, a Stinking and Leprosy of the Body, with a lixivial Corruption of all the Juices; which are only to be avoided or cured by a Change of Diet, in which a vegetable Acidity abounds. Hence it is, that we are furnished but with few canine Teeth; and our Appetite, in
Health,

Health, but more especially in Disease, is stronger for acidulous Vegetables, in Proportion to our warmer Temperature of Body, and greater Heat of the Country, or the Season of the Year.

Hence we see, that, in the hottest Climates, People live either altogether upon Vegetables, or use Flesh Meats but very rarely, and not without Danger of acute Diseases; while, in the colder Countries, Flesh is eat freely with less Danger: And hence Bread, or something like it, is made a standing Part of our Food, throughout the World.

The best Drink is afforded by pure Water not incorporated with Salts, nor with Air; by which it may readily enter into a Fermentation. Of this Kind, we justly prefer that from a mountainous Spring, which runs clear and cold through a sandy Bed, being very light and insipid. Whenever we are unprovided with such pure and healthy Water, as is frequently the Case in low flat Countries, or when any Increase of the Strength and muscular Constriction of the Stomach is required, from a spicy Stimulus, its Place may be very well supplied by Wine, prepared chiefly from Grapes; but, in defect of those, from Apples and Pears; which, after a due Fermentation, becomes clear, and is replenished with an acid Salt, and oily or inflammable Spirit, but more flatulent, heavy, and less palatable, are prepared from the several Kinds of Corn, opened by Maceration and slight Roasting, and afterwards extracted with boiling Water, and prepared by Fermentation, as a Substitute for Wine, to those Countries where the Grape does not ripen.

But Mankind have invented various Pickles and Sauces; such as Salt, Vinegar, and Acids of various Kinds, to correct the putrescent Disposition of Flesh Meats; with Pepper, Mustard, and other hot Spices, to strengthen the Action of the Stomach, which is perpetually weakened by flatulent

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Vegetables: And to these add, the Sugar, Salt, and eastern Spices, which are generally added, either for the Sake of Flavour, or preserving our Food. But all these yield no Nourishment; being destitute of all gelatinous Lymph, or any farinaceous Quality.

The Aliments are generally dressed, or variously prepared, according to their different Natures, the Country, Season, &c. by which their Crudity is removed, their solid Fibres softened or opened, their too much incorporated Air expelled, or their disagreeable Acrimony reduced or changed to a Flavour that is agreeable: But, even after this, many vegetable Foods, and more especially Flesh-Meats, require to be divided, in some Degree, by a previous Triture in the Mouth, which is more especially necessary in Man, whose Stomach is very thin, or but little fleshy; and likewise, that the Food may not stay so long upon the Stomach as to become putrid. HALLER's Prim. Lin. Physiol.

N. B. Several Authors of Credit relate Cases of Persons who have lived several Years upon Barley-Water, Whey, or even simple Water, only. Perhaps an Account of some of these Cases may not be disagreeable to the Reader; not that I would advise any Person to try the Experiment.

C A S E I.

In the Month of July, about eighteen Years past, one JOHN FERGUSON*, Herdman of the Parish of Kilmelford in Argyleshire in Scotland, of the Age of Thirty-eight Years, on a warm Day

* Who now lives, and, for the Space of eighteen Years last past, hath subsisted only on Water, Whey, or Barley-Water: Attested to the ROYAL SOCIETY, on Thursday the 9th Day of December, 1742, by Mr. CHARLES CAMPBELL, Preacher of the Gospel in Scotland; who, living near the said FERGUSON, had been in Company, and discoursed with him.

over-heating himself in Chace of Cattle, drank plentifully of cold River Water, whereupon he fell asleep by the River Side, and slept for Twenty-four Hours. On waking, he found himself in a violent Fever, was carried Home, and there desiring Drink, they gave him Water, on drinking whereof he vomited; ever since which Time he hath not been able to contain in his Stomach any Thing except Water, Whey, or Barley-Water. In the Summer Season he useth for his Food only cold Water, and in Winter only warm Whey, or Barley-Water. If, in drinking the Barley-Water, one Grain of the Barley should accidentally be swallowed, his Stomach immediately ejects the same by Vomit. In order to discover whether any Fallacy might be used, the said FERGUSON hath been, by his Father's Master, confined in a Room for twenty Days, during which Time he lived only on Water, Whey, or Barley-Water; and, during that Time, had no Stool. He hath a florid fresh Countenance, seems as other Men in other Respects, but is weak, and not so fit for Labour. His Evacuation by Urine seemeth in Proportion to the Quantity he drinks; and he generally, in his Business, walketh about five Miles every Day.

C A S E II.

We likewise read*, That, in the Year 1595, a Girl, of about Fourteen Years of Age, who was brought to Cologn, had lived three Years without eating or drinking. This was verified by the Parents of the Girl, and other creditable Testimonies. FABRICIUS strictly examined her: She had a dull melancholy Countenance, her Body moderately fleshy, except her Belly, which was depressed

* Cent. ii. Observ. 40.

and retracted to the Spine of her Back: The Liver and the rest of the Viscera to him seemed schirrous; she never went to Stool: She loathed all Food to such a Degree, that if any one suddenly put a Bit of Sugar in her Mouth, she immediately fainted: She danced and played with other Children, and seemed as if she ailed nothing; and her Body had its natural Colour. Her Parents told him, that about seven Years before that Time she had recovered from a dangerous Illness; and that, by little and little, she began to loath all Food; so that, in the Space of four Days, she tasted no Victuals: After which, subsisting only on a little new Milk, she at last, in the Space of six or seven Days, intirely abstained from eating or drinking.

C A S E III.

SENNERTUS * relates, That another Girl, of the same Age, at Confolentum, a City on the Confines of Limosin and Poictiers in France, who lived three Years without eating; an Account whereof was published by CITESIUS, a Physician. It appears, that in 1599, in the eleventh Year of her Age, she was seized with a Fever, attended with a Vomiting: That, on the Remission of the Fever, she became speechless, and remained so fourteen Days: When her Voice returned, she was delirious, and had neither Sense or Motion; and her Stomach became so weak, that she loathed all Food: That, after six Months, she began to recover the Use of her Limbs, her Stomach yet remaining in the same State: Her Abdomen fell in, so that from below her Ribs to the Os Pubis, she was much altered from what she used to be, and seemed as if all the Muscles of the Abdomen, the

* Tom. II. Lib. III. Par. i. Sect. 2. De Longa Abstinencia.

Intestines, Viscera, and all her internal Parts, had been taken from her : The other Parts of her Body seemed not thus emaciated ; her Chest seemed full, her Breasts moderately turgid, her Arms, Thighs, and Legs, sufficiently fleshy, her Face plump, her Lips were of a dark red Colour, her Tongue contracted, yet her Speech was free ; the Hair of her Head was very long, her Hair, Nails, yea all her Body, seemed augmented. She had no Discharge either by the Anus, Bladder, Uterus, or Cutis ; she seemed, to the Touch, to be always cold and dry, and hardly, by any Motion, grew warm, tho' she was busied in her household Affairs. She went to Market, swept the Rooms, spun, and did other Things of this Nature, her Senses and Motion being in no Manner prejudiced.

C A S E IV.

The same Author reports this Case *, taken from the Genoese Physicians, That, in 1601, a brisk lively Woman, of about Twenty-two Years of Age, was conveyed to Genoa, who was kept in Custody, with a watchful Eye over her, and was found to live many Years only on Water.

C A S E V.

We also read †, That a Girl, called APOLLONIA, born at Gatz, in the Jurisdiction of Bern, a City of the Switzers, who at first had an Aversion to Bread, and afterwards to all other Victuals, and was nourished by Broths only ; which, by degrees, she likewise abhorring, used only some Spoonfuls of Wine, diluted with Water ; which she also at last refused, and lived some Months without eating or drinking. The Senate of Bern being in-

* Ibid.

† Ibid.

formed hereof, ordered, that the Mother and the Girl should be put into the Hospital of the City for the Discovery of any Fraud that might be used; whereupon, under the strictest Observation, she was found to live without Aliment. What was further remarkable in this Person was, that the Flies, of which there was great Plenty in the Stove-room where she lay, settling on her Face, and other naked Parts of her Body, were not at all perceived by her; neither was she much affected by cold Winter Weather. She was in Switzerland in the Year 1600, and remained in this State till the Year 1612; when, about Christmas-Day, her Appetite began a little to return, and, by degrees, her Stomach, Liver, and other Parts, returned to their natural State; her Abdomen, which before was extenuated and hardened, again became softened and elevated, her Excretions were again had as before, her muscular Strength returned; and she, who had lived above ten Years in a weak Condition, without eating or drinking, became capable of going about and doing her Business: Yet her Senses, which, during the Time of her Abstinence, remained intire, began to grow languid, and her Head so affected, that she became, in a Manner, foolish.

C A S E VI.

I shall mention only one Case more, of this Nature, from the same Author*, concerning a young Woman, born at Halberstad, in Germany, who lived above nine Years without eating.

In the Year 1614, she was taken ill, and continued so for fourteen Days. During the Time of her Illness she eat nothing: When she recovered,

* Ibid. p. 385.

she had such an Aversion to Victuals, that, in the Space of a Day, she hardly eat any Thing: Afterwards, being invited to a Wedding, she, by Intreaty, eating more than usual, became so ill for eight Days, that her Life was despaired of: From this Time to her Death, she eat nothing, but every Day drank about a Pint and a Half of Ale, in which, if they put, unknown to her, any Bread, she would not drink. Her Body was of a good Colour, and not emaciated. She was weak, and therefore obliged to live a sedentary Life. She died in 1623, in a dejected melancholy State, caused by the coming of some insolent Soldiers which her Mother was obliged to take in.





LECTURE VI.

Of the Nature of the CHYLE, or NUTRITIOUS SUBSTANCE.



ALIMENTS of every Kind, whether solid or fluid, are not only in the Stomach, but also in the Duodenum, which is a kind of succedaneous Stomach, and in the Whole of the small Intestines, by the Warmth of the Parts, and the Assistance of the gastric Lymph and the Bile, dissolved and converted into an alimentary Liquor called Chyle; which, being secreted through the Intestines, from the recrementitious Mass of Aliments, to be discharged by way of Excrements, is, by a peculiar Mechanism, conveyed to the Mass of Blood.

That the Duodenum is a succedaneous Stomach, is obvious, from this, that it is sufficiently large, and has a Flexure like that of the Stomach; by means of which, the Mass of Aliments may be the longer retained in it. It is also furnished with Menstruums, or solvent Liquors, peculiar to itself; since not only a large Number of small Glands, detected by BRUNERUS, which discharge a menstruous Lymph, are situated in it; but also, because the pancreatic Juice, mixing with the Bile, accomplishes the farther Elaboration and Rectification of the Chyle.

The Chyle itself is a milky insipid Liquor, consisting of oleous and mucilaginous Parts, and extracted from the dissolved Aliments.

It is, as it were, a natural Emulsion: And as, in order to constitute this, a Mixture of oleous and aqueous Parts is requisite; so, that the Chyle consists of the same Ingredients, is obvious, from those Particles, in Milk, which is nothing but Chyle, being converted into Butter, Cheese, and Serum. And as every artificial Emulsion, prepared with Water and oleous Seeds bruised, is of a whitish Colour, which arises from the Oil, reduced to small Globules, reflecting the Rays of Light; so, also, the Whiteness of the Chyle can hardly be ascribed to any other Cause than this.

BOERHAAVE has set the Analogy between Emulsions of Vegetables and Chyle in a very clear Light. He speaks only of Vegetable Substances; but if we reflect, that animal Substances, taken by way of Aliment, are originally formed from Vegetables, and, like them, consist of Oil, Earth, Water, and Salts (the last volatile); we shall readily conceive how the Organs of Digestion convert also animal Substances into Chyle, or a sort of Emulsion.

The Passage hinted at, in BOERHAAVE, runs thus: 1. If the oleaginous vegetable Substances are reduced to a Powder, or bruised, and ground in a marble Mortar with a wooden Pestle, and a little Water be slowly and successively poured upon them in the grinding, that they may then come into a well-wrought Paste, they will change into a white Mass; which the longer it is so ground, the more uniform it becomes, and the better fitted for this Process. 2. Then gradually add more fair Water, so as to make the Whole fluid, and continue the Triture without Intermision, as before; whereby the Liquor, floating above the Matter,
will

will begin to grow milky and unctuous: Let the Liquor now rest a little, then pour it off, by a gentle Inclination of the Mortar, upon a thin linen Strainer, that the finer Part may pass through into a clear Vessel. 3. To the gross Part remaining behind in the Mortar, and in the Strainer, again add fresh Water, and grind and strain as before, adding this second Liquor to the former, and repeating this for several Times, till the Liquor poured off gradually becomes less white, thick, and unctuous, and, at length, perfectly aqueous, at which Time but a very little of the Substance will remain in the Mortar, and that chaffy, poor, exhausted, and insoluble in Water, though assisted by long Triture, appearing almost merely terrestrial, without Salt, or the least Signs of Oil: Whence, by this means, the Parts of Vegetables, filled with Oil, are divided into two distinct Kinds; one dissolvable by Water, the other not.

The Liquor, thus prepared, resembles, in many Respects, the Chyle of Animals, which is itself prepared from Vegetables in their Bodies, by chewing, ruminating, and the Action of the Stomach, before it is mixed with the Bile in the Duodenum. The Thing appears evident, from the white Colour, mild Odour, sweet Taste, thick Unctuousness, and great Disposition they both have to turn sour. So, likewise, if the Liquor, thus prepared, stands some Time in a tall cylindrical Vessel, it spontaneously separates into a white, thick, and almost totally oily Part, which floats at Top, and into a thinner, transparent, bluish Colour, which remains below, wherein it perfectly resembles Milk, as dividing itself into Cream and thin Milk.

Again; if this Liquor be kept, for some Time, in a warm Air, it turns sour, and afterwards considerably sharp, though without acquiring the proper Rancidness of an expressed Oil, in which Respect,

spect, also, it perfectly agrees with Milk, which acquires the like Acidity in such an Air, without becoming rancid like pure Oil. Whence this farther Remark should be made; that, in acute Distempers, Emulsions may be given with greater Safety than expressed Oils. But I could never, by any Art of Coagulation I have used, obtain such a Curd, from this Liquor, as Milk affords; whence there is this Difference betwixt the Milk of Vegetables and Animals. The Reason of the Difference between expressed Oils and Emulsions seems principally this; that the meally Part, in the Grinding, being constantly in fine Particles, interposed betwixt the pure Oil, the Parts of this Oil are so broken, and separated from one another, that, its Tenacity being changed, it becomes miscible with Water, and thence appears in the Form of Milk, which also consists of a fat Substance dissolved in Water; whereas, when a pure Oil, it is obtained by Expression; the Parts thereof, being in Contact with each other, do not admit of Water, nor suffer it to be mixed among them. Again, the large Quantity of Meal, intermixed with the Oil in the Emulsion, causes it to turn sour, not rancid; and hence appears the Reason why the Liquor is white: For Whiteness always ensues, as often as Oil is intimately divided, and mixed with Water.

If Oil be poured upon a Glass of Water, the two Liquors will remain transparent, and separate; but, if shook briskly together, they will unite, in some measure; and, during that Union, the Mixture will appear perfectly white; but, if suffered to rest, the Oil is collected at the Top, the Water sinks to the Bottom, and the Whiteness immediately vanishes: And the same Thing frequently happens in animal Milk, distilled oleaginous Waters, and these Emulsions.

It is also certain, that the Whiteness becomes greater, the larger the Quantity of Oil; and, in this Case, the Liquor sooner grows rancid; but the less the Oil, the less white the Liquor, and the sooner it turns sour. In the Summer, Emulsions will scarce keep ten Hours; but in Winter longer. To conclude, this Method of making Emulsions gives Light to the Action of Mastication: For all the Foods prepared from Corn, abounding with a latent Oil, and being ground by the Teeth in Chewing, and mixed with the Saliva; the longer they are thus acted upon in the Mouth, the nearer they approach to these Emulsions, and at length always turn white, when the Saliva, Salt, and Oil, are well ground together. The Operation, thus begun in the Mouth, is carried on, in the Stomach, and more perfected in the Intestines, where the Matter still retains the same Nature, except that new Juices are perpetually mixing themselves therewith, and communicating their Properties; whereas, in our pharmaceutical Operations, there is no Addition but of Water alone. And hence we may understand the artificial Distinction between the first Chyle, and the Milk of Animals.

Hence we also learn the Origin of Fat in Animals which feed upon Vegetables; since Vegetables constantly abound with Oil, which may be prepared and extracted from them by chewing, ruminating, and the Power which the Body has of making the Chyle. 2. We hence see the Nature and Use of this Oil in Plants. 3. So we likewise learn the Manner whereby a Liquor, extremely like Chyle and Milk, may be produced from Oil and Water, mixed and ground together in a certain Manner; and hence perceive how the human Body acts in producing Chyle and Milk. 4. Hereby we are gradually led to consider those Oils called essential. 5. Physicians, acquainted with these
Par-

Particulars, will not wonder whence Men in Health, who use little Exercise, should abound in Fat, even though they often use nothing but vegetable Food; since Expression and Emulsion can so easily extract a large Quantity of Oil from Vegetables not apparently oily. 6. Hence we see the Origin both of Chyle and Milk: And, 7. The Nature of those Principles which constitute them both; which are the animal Juices, consisting of Saliva, the Mucus of the Mouth, Oesophagus, Stomach, and Intestines; and, again, of those aqueous, saponaceous, oily, and spirituous Matters, in the Liquors enumerated, which may be brought into the Form of an Emulsion, and expressed from the grosser Parts by means of Mastication, Deglutition, the Action of the Stomach, and the peristaltic Motion. 8. Hence also may be easily deduced the physical Reason why the Milk of Animals, prepared intirely from vegetable and tartish Food, is so subject to turn sour, when out of the Body. Recent verdant Grass, by being long masticated, or ruminated, with a large Proportion of Saliva, begins, even in the Mouth, to assume the Form of Milk, and promote the Production of Fat; whence Men usually grow fat with Bread and Water, and Cattle with Water and Grass.

Since the principal Aliment of the Chyle is an Oil, blended with a mild, gelatinous, and mucilaginous Substance; it is obvious, that those Substances afford the most copious and laudable Chyle, which are endowed with a mild, oleous, and mucous Juice, such as the Flesh of Animals; and, in the vegetable Kingdom, all the farinaceous Seeds.

Hence the Reason is evident, why a Man may live upon Water and Bread alone: For these Substances include, in a due Degree and Proportion, all the Ingredients of the Chyle and Blood.

From this it also appears why, in the Eastern Countries, Rice serves the Inhabitants instead of Bread, Wheat, Oats, Peas, Beans, and Chesnuts; not only Man, but every other Species of Animals, become fat: Hence also the Reason is obvious, why those Aliments, which are not of a temperate Quality, such as acid, spirituous and saline Substances, the Juices of many Vegetables, Herbs, Roots, with acrid and aromatic Substances, are improper for producing Chyle and Nutrition.

The Chyle, extracted from dissolved Aliments, is strained through the villous Membrane of the small Intestines, conveyed to the small Orifices of the lacteal Vessels, and poured into them.

This villous Tunic, which is most conspicuous in the Jejunum, is no more than a Congeries of a large Number of villous Substances, or small Tubes variously interwoven with each other; and this Congeries is the Source and Origin of the lacteal Vessels.

That the Villi of the Intestines are furnished with Cavities observable by Microscopes, is excellently demonstrated by BRUNERUS, in his Treatise *De Glandulis Intestinorum*. From the same Author we learn, that where there are intestinal Villi, there are also lacteal Vessels; and that where the former of these are not to be seen (as in the Stomach, for instance), there the lacteal Vessels are invisible.

The villous Membrane of the Intestines is not merely passive, but, in consequence of the Afflux of the nervous Fluid and Blood, is provided with a certain Degree of Strength and Tone, or a Motion by which it is contracted and dilated; so that these small villous Canals, and the Orifices of the lacteal Vessels, may be either too much contracted, or relaxed.

In Spasms and Gripes of the Intestines, as also upon the Use of acrid Purgatives, or corrosive Poisons, this villous Membrane is highly constricted; so that nothing, except a fine thin Fluid, can pass through it, as is sufficiently evinced by the Symptoms common to hypochondriac Patients, and by the Flatulencies and Congestions of peccant Humours usual in such a Case.

The villous Membrane, with which the small Intestines especially are furnished, is that common Strainer through which all the Liquor is conveyed from the Primæ Viæ to the Blood, and all the other Parts of the Body: Hence it is of the utmost Importance, that this villous Membrane should be in its due and natural State; for if the Apertures of the Vessels are too wide and pervious, the gross, seculent, and recrementitious Parts of the Chyle, are conveyed to the Blood. If, on the contrary, they are too much contracted, the thin and watery Part of the Chyle is only conveyed to the Blood; whereas the more useful and alimentary Portions of it are kept back.

What Alteration the Chyle undergoes within the cellular Texture of the mesenteric Glands, is not yet sufficiently known: But it appears, in general, that some thin Liquor distils from the Arteries in this Part serving to dilute the Chyle into which it is poured. For it is observed, that, after the Chyle has passed all the Glands, it appears more aqueous; and thin Liquors, injected through the Arteries, flow out into the cellular Texture of the Glands, and are diffused into the Lymphatics.

From the last Glandules which are collected together in the Center of the Mesentery, a few, but very large, lacteal Vessels arise, which ascend from all the inferior Parts of the Body, creep over the renal Vein, and then go, with this and the Hepatics, behind the Aorta, to the lumbar Glandules:

dules: Hence the Lymphatics assume a variable Course, but most frequently terminate in a Vesicle of considerable Breadth, at the Side of the Aorta, between that and the right Appendix of the Diaphragm; there it usually appears somewhat turgid, two or more Inches long, and often ascends above the Diaphragm into the Thorax, conical both above and below. It is named *Receptaculum Chyli*, in which the gelatinous Lymph of the inferior Extremities, and of the abdominal Viscera, mixes with the Chyle, and dilutes its Whiteness*.

Since all the Chyle, and every other Fluid, must pass, into the Mass of Blood, through the minute capillary Vessels of this villous Membrane, and through the lacteal Vessels; hence these Ducts, and other Orifices, ought to be open and pervious, without Obstruction by any mucous Substance.

To obstruct these small Ducts of the villous Membrane, those Aliments greatly contribute, which are converted into a viscid Coagulum; such as hot Bread, farinaceous Substances, Cakes not sufficiently fermented, coagulated Milk, viscid and compact Aliments, Fat which easily runs into a Coagulum, such as that of Sheep, together with all Aliments and Medicines possessed of an astringent Quality.

Bountiful Nature has therefore wisely appointed that the Bile, in consequence of its saponaceous and abstergent Quality; and the Lymph, in consequence of its being incessantly discharged from the Glands and glandular Tunics, should preserve this villous Membrane from being obstructed by any thick and viscid Mucus.

* But there are some Instances, where there are only two or three small, and somewhat angular Ducts, instead of this *Receptaculum Chyli*, or Cistern of the Chyle or lymphatic Vessels, which may be owing to the considerable alternate Pressure of the Diaphragm and Aorta; by which means, the Chyle is moved faster or slower.

Hence the Reason is evident, why the drinking of good Waters, warm Infusions of Tea and Coffee, together with Decoctions of Herbs, is so highly beneficial; since the principal Advantage, attending the Use of these Liquors, consists in this, that they keep this Membrane free from Obstructions, and preserve its Ducts open and pervious. Hence, also, it is obvious, why these Liquors, or any wholesome Waters, drank copiously, when, in consequence of the obstructed Vessels, they cannot find a free and easy Passage, excite Commotions, Flatulencies, Uneasiness, and sometimes Vomitings. Warm Fluids, how ever drank in too large Quantities, and too frequently repeated, will relax the villous Membrane, and prove highly prejudicial.

Through the villous Membrane of the Intestines there is, first of all, secreted from the Aliments, a very fine Fluid, which easily enters and passes through the several Ducts.

Hence after Meals, or drinking liberally, even of good Water, the Urine is first discharged, purely aqueous and insipid, but afterwards assumes a deeper Colour.

The Chyle does not immediately incorporate with the Blood, so as to change its Nature, as we observe from the Milk which is afterwards made of it; but about five or more Hours after a Meal, during which Space a Woman will afford Milk, after it has circulated eighty Thousand Times through the Body, fermented with Heat, and mixed with a Variety of animal Juices; it is, at length, so changed, that some of its Particles are deposited in the cellular Substance, under the Name of Fat; another Portion is configured into red Globules; and, again, another Portion into a mucous or gelatinous Substance, and into Serum: The aqueous Particles

go off, in some measure, by Urine; and some exhale by Perspiration. Hence we see that the different Particles of the Chyle are distributed according to the Laws of the Animal Oeconomy.

The more gross and coarse Parts of the Aliment, which are not adapted to the Apertures of the lacteal Vessels, are not conveyed to the Blood; but, being retained in the Intestines in consequence of the Narrowness of the Lacteals, are discharged by way of Excrement.

If, in consequence of the costive State of the Body, the more gross Parts of the Aliment remain, for a considerable Time, in the Intestines; the more gross, saline, and terrestrial Parts, also, by the strong Compression of the Intestines, penetrate into the Blood.

But a Liquor is not only secreted in the small, but also in the large Intestines, and conveyed into the Mass of Blood through the absorbent Vessels.

When any one is preternaturally costive, the Fæces, which were before discharged liquid, and of a foetid Smell, are now destitute of Moisture, and free from that ungrateful Scent; which is a satisfactory Proof that this foetid Liquor has been absorbed from them.

From what has been said, we may easily assign a Reason why a costive State should produce a Cachymy, and render the Humours highly impure. That there is also a Secretion made in the large Intestines, is sufficiently obvious, from what we call nutritive Clysters, prepared of Peruvian Bark; as also from antispasmodic and corroborating Clysters, prepared of nervous and cephalic Herbs, and calculated for Disorders of the Head.

The Stomach and Intestines have a particular Motion, by which they are contracted and dilated: Their Motion proceeds gradually from the superior

rior to the inferior Parts, and is by the Greeks called the peristaltic Motion.

The principal Instruments by which this Motion is performed, are the annular Fibres, with which the whole Intestines are surrounded, and wrapped up, in a spiral Form; so that these Fibres are continued, in an uninterrupted Course, from the Oesophagus to the Anus.

This Assertion may be confirmed by the following Experiment: Boil the Intestines of any Animal, and, after separating the longitudinal Fibres, together with the exterior Membrane, the annular Fibres, in one continued and uninterrupted Series, may be separated from the Intestine, like a long Thread.

These annular Fibres, with the Assistance of the longitudinal, are the principal Instruments, by means of which the Contraction of the Intestines is produced.

The peristaltic Motion of the Intestines, when in its natural State, is very easy and gentle.

This easy and gentle Motion may be justly looked upon as the wise and bountiful Appointment of Nature; lest the Aliments, when concocted, should be with too much Precipitation hurried into the Intestines, and too speedily discharged; which happens in a Diarrhæa. Besides, in consequence of the gentle Contraction and Dilatation of the Intestines, only the finer and more subtil Portion of the Chyle is separated from the Mass of digested Aliments, and poured into the villous Ducts of the Intestines, and the Apertures of the lacteal Vessels; whilst, at the same Time, the more gross and feculent Parts are left, just as happens in all Percolations; where the Strainer, upon a gentle Compression, only transmits the finer Parts; whereas, by a stronger and more forcible Compression, its thick and turbid Parts are, at the same

Time, passed through it. But this intestinal Motion is not perceptible, except in the largest Animals, such as Oxen and Horses, when dissected alive.

As every Impulse and progressive Motion of Humours require a Cause or Principle sufficiently qualified for producing a due Degree of Motion; so, with respect to the peristaltic Motion of the Stomach and Intestines, we find a threefold Cause; the first of which is lodged in the Pharynx, the second in the Pylorus, and the third in the Beginning of the Intestinum Colon.

By a strong Contraction of the Pharynx and the Tongue, the Aliments are thrust into the Cavity of the Stomach, through the Oesophagus; then, by the right and inferior Parts of the Stomach, by means of the Action of the Pylorus, the Contents of the Stomach are propelled through the small Intestines, till they arrive at such as are larger, and more capacious; where, about the right Ileum, is the Beginning of the Colon, which consists of very strong, nervous, muscular, and fibrous Membranes, and by whose Motion and Impulse the Excrements are forced to the Anus.

The Motion of the Intestines, by means of which their Contents are propelled or carried forwards, is sufficiently strong, since it overcomes a considerable Resistance, and forces Quicksilver, almost the heaviest of all Minerals, up and down, through all their various Convolutions and Windings, till it is discharged by the Anus; which we observe in those afflicted with the Iliac Passion, who often receive considerable Relief by taking large Quantities of this metalline Fluid*.

* Provided the Introsusception arises from the inferior Portion of the Intestine; otherwise this Fluid will increase the Disorder to a fatal Catastrophe: As I found in some Subjects who died of this Disease.

This Motion, whereby the Intestines are contracted and dilated, is successive and reciprocal. For while one Part of the Intestine is contracted, and rendered narrower; the Substance contained in it is pushed forward to the adjacent Part; which, by that means, is dilated; and, upon the Cessation of that Dilatation, is forthwith contracted again.

As, in order to preserve the continual Circulation and progressive Motion of the Blood and Humours, such is the Construction of the moving Fibres, in the Heart and Arteries, that their Dilatation or Diastole becomes the Cause of their Systole, which again produces their Diastole: So also the like Condition of moving Membranes and Fibres is observed in the Structure of the Intestines; so that their Dilatation produces their Contraction, and, vice versa, their Contraction proves the Cause of their Dilatation.

If then the Contraction of the Intestines is the Cause of their Dilatation; and if, on the contrary, their Dilatation gives Birth to their Contraction; it follows, that, by producing either a stronger Dilatation or Contraction only in one Part of the Stomach and Intestines; the peristaltic Motion, in general, must by that means be accelerated, and the Fæces, of course, more speedily evacuated.

Hence the Reason may easily be understood, why, by a purgative Medicine, which is frequently lodged in one Part of the Intestine, and excites a painful Constriction, the Contents of the Intestines are as speedily and forcibly discharged, as we observe them to be in acrid Humours and bilious Diarrhæas. Hence the Reason is also obvious, why, by drinking copiously of any Liquor which is impregnated with a stimulating, and especially a saline Principle, the Contents of the Intestines are soon expelled, as we observe in drinking hot and acidulated Waters.

As the Strength, Tone, and contractile Force, of all the moving Parts of the human Body, depend upon a free and uninterrupted Influx of the fine nervous Fluid, and the purer Part of the Blood; so the peristaltic Motion of the Stomach and Intestines depends upon the same Cause.

All those Medicines which increase the Strength, and augment and restore the Vigour and Tone of the Parts; such as Substances impregnated with a highly subtil, fragrant, oleous and aromatic Oil; or such as contain a volatile subtil Salt, or such as abound with a mild and balsamic Resin; are excellent Preservatives of the Motion of the Intestines, and restore it when become too languid: Whereas, on the contrary, Substances which impair the Strength, such as foetid Medicines, Opiates, too powerful Refrigerents, Acids, and Astringents, greatly impair the Vigour of these Parts. But that the nervous Fluid is subservient to the Motion of the Intestines, is, I think, obvious; because the Passions of the Mind, which principally act upon this Fluid, may also alter, increase or destroy, the natural Motion of the Stomach and Intestines.

The peristaltic Motion, therefore, of the Intestines, is the principal Cause, both of the Secretion of the Chyle, and of its Conveyance through the lacteal Vessels. Besides, the progressive Motion of the Chyle to the Mass of Blood is not a little assisted, first, by what we call the Valvulæ Conniventes, large Numbers of which are observable in the small Intestines, which, when a Compression of the Parts is made, hinder the Chyle from slipping instantaneously by the Orifices of the Lacteals and the intestinal Villi: For in these the Mass of digested Aliments ought to remain for some Time, that the Chyle may be the better expressed from it, and conveyed purer and better into the lacteal Vessels.

Vessels. Secondly, To the more easy Reception of the Chyle into the small lacteal Vessels, and the intestinal Villi, the Narrowness of their Diameters contributes not a little; which is confirmed by Experiments made with capillary glass Tubes; in which Fluids will spontaneously ascend. Thirdly, The progressive Motion of the Chyle, and its Ascent through the lacteal Vessels and thoracic Duct, is much assisted by the semilunar Valves, with which they are furnished: For these Valves consist of slender and moving fleshy Fibres, by whose Motion the Fluid is carried from one Valve to another. These Valves are so situated, that the Chyle and Lymph may be carried upwards with a progressive Motion, but cannot regurgitate, or have a retrograde Motion. Fourthly, The Progress of the Chyle is also assisted and promoted by the Impulse of the Fibres; of which those remarkable conglobate Glands, situated at the Center of the Mesentery, consist.

The Progress of the Chyle, through the thoracic Duct and lacteal Vessels, to the Blood, is considerably promoted, likewise, by Respiration; in which there is a continual and successive Contraction and Dilatation of the Muscles of the Abdomen.

Since, in Inspiration and Expiration, the strong Contraction and Dilatation of the abdominal Muscles not only force the Aliments from the Stomach and Intestines, but also promote the Expression of the Chyle; it is for this Reason prejudicial both to Digestion and to Health, after a liberal Meal to talk too loud, or to use too violent Exercise: But four or five Hours after, when the Digestion is finished, Motion and Exercise are so far from being hurtful, that they are rather beneficial; as, by increasing Respiration, the Secretion and progressive Motion of the Chyle are more effectually promoted. FRED. HOFFMAN, Tom. I.



LECTURE VII.

Of the LIVER.



THE Liver is the largest Gland of the Body, and of a pretty compact Substance; commonly of a dark red Colour, a little inclined to yellow, situated immediately under the Arch of the Diaphragm, partly in the right Hypochondrium, which it almost intirely fills; and partly in the Epigastrium, between the Appendix Eniformis and Spina Dorfi; terminating, commonly, in the left Hypochondrium, into which it sometimes runs a considerable Way.

The Figure of the Liver is irregular; it being convex on the superior Surface, unequally concave on the inferior, and very thick on the right and posterior Sides. Towards the left anterior Side, its Thickness decreases very much, and terminates there by a kind of Edge; and it is broader from right to left, than from before backwards.

The Liver may be divided into two Extremities, one major, the other minor; two Edges, one anterior, the other posterior; two Surfaces, one superior and convex, which is smooth, and proportioned to the Arch of the Diaphragm; the other inferior, concave, and uneven, with several Eminences and Depressions.

It may likewise be divided into two lateral Parts, called Lobes; one of which is termed the major or right Lobe, the other the minor or left Lobe.

These

These two Lobes are distinguished above by a membranous Ligament; and below, very plainly, by a considerable Scissure, lying in the same Direction with the superior Ligament.

The Eminences on the concave Side of the Liver belong to the major Lobe. The principal Eminence is a Sort of triangular or pyramidal Apophysis, situated posteriorly near the great Scissure, which distinguishes the two Lobes.

This triangular Eminence is termed Lobulus Spigellii, or Lobule of the Liver: One of its Angles advances a considerable Way towards the Middle of the inferior Side of the great Lobe, and is lost there.

This Angle is like the Base of the Lobulus. Towards the anterior Side there is another Eminence, less prominent, but broader; and to this Eminence, and the former, the Antients gave the general Name of Portæ.

The Depressions on the concave or inferior Side of the Liver, which deserve our Attention, are four in Number. The first is, the Scissure that separates the two Lobes which run across the concave Side, from the Eminences already mentioned, to the anterior Edge, where it terminates, by a Sinus of different Depths in different Subjects: This is termed the great Scissure of the Liver; and, in some Subjects, Part of it is tubular.

The second Depression is situated transversely between the two Eminences of the great Lobe, and filled by the Sinus of the Vena Porta; so called, by the Antients, because it lies between the Eminences of the same Name.

The third Depression is posteriorly, between the great Lobe and Lobulus Spigellii; and the Vena Cava passes through it.

The fourth is a kind of Sulcus between the Lobulus and small Lobe of the Liver, which, in the Fœtus,

Fœtus, served to receive a venal Canal; but is degenerated, in Adults, into a kind of Ligament.

This Sulcus is, in some measure, a Continuation of the great Scissure, and makes an acute Angle with the Vena Cava.

Besides these four Depressions, there is one, on the anterior Surface of the great Lobe, in which the Vesicula Fellis resides; and it sometimes runs as far as the Edge, where it forms a small Sinus. We may likewise reckon, among these Depressions, a small superficial Cavity in the posterior and lateral Part of the inferior Side of the great Lobe, by which it rests on the right Kidney; and likewise a superficial Cavity in the left Lobe, where it runs over the Stomach.

Lastly, On the posterior Margin of the Liver there is a great Sinus, common to both Lobes, which gives Passage to the Spina Dorsi and Oesophagus, near the Place where the Vena Cava descends: And we sometimes meet with Scissures, on both Sides of the Liver, which are not common.

LIGAMENTS of the LIVER.

The convex Side of the Liver is commonly connected to the Diaphragm by three Ligaments, which are only Continuations of the membranous Laminæ of the Peritonæum. One lies near the utmost Extremity of each Lobe, and one in the Middle; and they are accordingly termed the right, middle, and left Ligaments.

There is a cellular Substance, in the Duplication of each, in which the sanguinous and lymphatic Vessels run, which sends off a kind of Lamina into the Substance of the Liver.

The right Ligament sometimes connects the great Lobe to the Cartilages of the false Ribs; and the left Ligament, or that of the small Lobe, is often double, and advances towards the middle
Li-

Ligament. This middle Ligament begins low, in the great Scissure of the Liver, near the Eminences called Portæ; and from thence passes thro' the anterior Sinus, and over the convex Side of the Liver at the Union of the two Lobes, and is fixed obliquely in the Diaphragm.

It is likewise fixed superiorly and interiorly to the right Vagina of the Musculus Rectus obliquely, in such a Manner, as to be nearer the Linea Alba inferiorly.

Besides these Ligaments, the great Lobe is likewise connected to the right Ala of the tendinous Portion of the Diaphragm, not by a Ligament, but by a broad and immediate Adhesion, without the Intervention of the Membrane of the Peritonæum, which is only folded quite round this Adhesion, to form the external Membrane of all the rest of the Body of the Liver.

This broad or strong Adhesion is commonly, though improperly, called Ligamentum Coronarium: But, in the first Place, it is not a Ligament, as has been already observed; and, secondly, it is not circular, but oval, and very oblong.

It is not on the superior Part of the convex Side of the Liver, but along the posterior of the great Lobe, the broad Extremity of the Adhesion, lying nearer the Sinus, and the pointed Extremity towards the right Hypochondrium.

The middle Ligament, improperly called Ligamentum Hepatis Suspensorium, contains in its Duplicature a thick white Rope, like a round Ligament, which was the umbilical Vein in the Fœtus. Thus the inferior Part represents a Falx, the convex Edge of which is sharp, and the other rounded.

All these Ligaments serve to keep the Liver in its proper Situation, and to hinder it from inclining

clining too much towards either Side : But we must not imagine that any of them serve to suspend it ; because it is sufficiently supported by the Stomach and Intestines, especially when they are filled.

When the Stomach is empty, or when we fast longer than ordinary, it is common to say, The Stomach pinches us : As the Liver is not then sustained by the Stomach and Intestines, it descends, by its own Weight, and, chiefly by means of the middle Ligament, pulls the Diaphragm along with it.

It is in that Place, therefore, that we have this uneasy Sensation ; and not at the superior Orifice of the Stomach, 'as is commonly believed.

The right or great Lobe of the Liver, which lies in the right Hypochondrium, rests on the right Kidney by the small superficial Depression before mentioned ; and it likewise covers a Portion of the Arch of the Colon and the Pylorus.

About two Thirds of the small or left Lobe lie in the Middle of the Epigastrium, and one Third advances over the Stomach, towards the left Hypochondrium.

This small Lobe is situated almost horizontally ; the great Lobe is very much inclined, and its thick Extremity runs down, almost in a perpendicular Direction, to the right Kidney, on which it lies *, in the Manner already said.

Structure of the LIVER.

The Liver is composed of several kinds of Vessels, the Ramifications of which are multiplied in

* This Observation is very useful to distinguish the different Parts of the Liver in Wounds and surgical Operations.

It may likewise serve to direct us in examining a Liver when taken out of the Body ; the Situation of which may otherwise be very easily mistaken, especially that of the Parts of the concave Side and the Passage of the Vena Cava between the Substance of the great Lobe and the Lobulus Spigelli.

an astonishing Manner, and form, by the Intertexture of their capillary Extremities, innumerable Collections of small pulpy friable Corpuscles, which are looked upon to be so many Organs designed to separate, from the Mass of Blood, the Bile.

The greatest Part of these Vessels, from one End to the other, is included in a membranous Vagina called *Capsula Venæ Portæ*, or *Capsula Glissoni*; from GLISSON, who first described it particularly.

VENA PORTA HEPATICA.

The particular Trunk of the *Vena Porta Hepatica* is situated transversely between the broad anterior Eminence of the great Lobe of the Liver and the Root of the Lobulus, in a particular Scissure, and forms what is called the Sinus of the *Vena Porta*; from this Sinus five principal Branches go out, which are afterwards divided into Millions of Ramifications through the whole Substance of the Liver.

There the *Vena Porta* lays down the common Office of a Vein, and assumes that of an Artery as it enters and is again ramified in the Liver.

The Extremities of all these Ramifications of the Trunk of the *Vena Porta Hepatica* end in the pulpy friable Corpuscles, which seem to be thick villous Folliculi, when viewed thro' a Microscope in clear Water.

PORI BILARII, & DUCTUS HEPATICUS.

It is in these Folliculi that the Bile is secreted; and it is immediately collected in the same Number of Extremities of another kind of Vessels, which unite, by numerous Ramifications, into one

common Trunk: These Ramifications are termed *Pori Bilarii*, and the Trunk, *Ductus Hepaticus*; and the Ramifications of these two Kinds of Vessels are invested together by the Capsula of the *Vena Porta*. See *Ductus Choledochus*.

HEPATIC VEINS.

The Blood, deprived of this bilious Fluid, is conveyed to the Heart by a great Number of venal Ramifications, which afterwards unite into three principal Branches, besides others, that are less considerable, which terminate in the *Vena Cava*; and are all called by the Name of *Vena Hepatica*.

The capillary Extremities of the Ramifications of the *Vena Cava* join those of the *Vena Porta*, and accompany them through the Liver; and yet the great Branches of both Veins intersect each other in several Places.

When we cut the Liver in Slices, it is easy to distinguish, in each Slice, the Ramifications of the *Vena Cava*, from those of the *Vena Porta*; the first being thinnest and largest, and adhering closest to the Substance of the Liver: Whereas those of the *Vena Porta*, which are invested by the cellular Capsula, appear to be a little ruffled, when empty; because the cellular Capsula subsides, when it is cut; but the other Veins remain uniformly open, their Sides adhering to the Substance of the Liver.

HEPATIC ARTERY and VEINS.

The Liver receives, from the *Arteria Cæliaca*, a particular Branch termed *Arteria Hepatica*, which being very small, when compared with the Volume of that Viscus, seems designed only for its Nutrition, and not for the Secretion of the Bile, as some Anatomists have imagined. The *Plexus Hepaticus*

ticus formed by the Nervi Sympathetici, Maximi, & Medii, furnishes a great Number of Nerves to the Substance of the Liver. The Ramifications of the Artery and nervous Plexus are included in the cellular Capsula, together with those of the Vena Porta, and Pori Bilarii.

The Pulsation of this Artery has been, by some Anatomists, taken for that of the Capsula, and which they have endeavoured to explain the arterial Office of the Vena Porta by : But they have not considered, that the Blood, in this Vein, does not require to be pumped forwards ; because so swift a Motion would have been prejudicial to the Secretion of the fine Oil of the Bile, for which a slow, and almost insensible Motion is necessary.

The Liver is covered exteriorly with a particular Membrane, or Tunic, which is a Continuation of the Peritonæum ; there is likewise a membranous or filamentary Substance that runs through this whole Viscus, and connects the Ramifications and Extremities of all its Vessels to each other : This Substance seems to be a complicated Production of the Capsula of the Vena Porta, and of the external Membrane of the Liver.

The exterior Surface of this Tunic is very smooth, but that of the interior is uneven, being made up of a great Number of thin membranous Laminæ ; between which we observe, very distinctly, numerous lymphatic Vessels, on both the convex and concave Sides of the Liver : And it is more difficult to trace those which accompany the filamentary Substance through that Viscus.—

The Substance of the Liver is chiefly formed of an infinite Number of pulpy friable Corpuscles, each of which is bounded, and, in a manner, surrounded by a particular Expansion of the Capsula Glissoni ; and all these Expansions are connected

by the common Septa, in some measure resembling a Bee-hive.

These Corpuscles * have several Angles, especially on the interior Surface of the Liver; but near the Surface they are raised, in the Form of small Tubercles.

Their pulpy Texture appears like radiated Villi, a small void Space being left in the Middle of each.

DUCTUS CHOLEDOCHUS.

The hepatic Duct, or Trunk of the Pori Bilarii, having run a little Way, joins another Canal, called Ductus Cysticus, or Vesicularis, because it comes from the Vesicula Fellis, as shall be shewn in the Description of that Organ.

These two united Ducts form a common Trunk named Ductus Choledochus, because it conveys the Bile into the Duodenum: This Duct, having reached the Incurvation of the Duodenum, insinuates itself through the Tunics of that Intestine, and opens into the Cavity thereof, not by a round Papilla, but by an oblong Orifice, rounded superiorly, and contracted inferiorly, like a common Tooth-picker.

The Edges of this Orifice are raised, broad, and plaited; as may be seen, by making this Portion of the Duodenum swim in clear Water. At the Entry of this Orifice there is another smaller Opening distinct from it, which is the Orifice of the Ductus Pancreaticus.

* If we blow through a Pipe into the Vena Porta, Vena Cava, Arteria Hepatica, or Trunk of the Pori Bilarii, but especially through the two Veins; we observe the Liver to swell, and the Corpuscles, near the Surface are raised, and become more sensible. If we blow with a great Force, we burst these Corpuscles; and the Air, getting between them and the external Membrane, raises it, from the Substance of the Liver, in Blisters.

VESICULA FELLIS,

Or Gall Bladder, is a kind of small Bag, shaped like a Pear; that is, narrow at one End, and wide at the other. The wide Extremity is termed the Fundus, or Bottom; the narrow Extremity, the Cervix or Neck; and the middle Portion, the Body.

About one Third of the Body of the Vesicula lies in a Depression, on the concave Side of the Liver, from the Trunk or Sinus of the Vena Porta, where the Neck is situated, to the anterior Edge of the great Lobe, a little towards the right Side, where the Bottom is placed, and, in some Subjects, it advances beyond the Edge*.

The Gall-Bladder is composed of several Tunics, the exterior of which is a Continuation of that which invests the Liver, and, consequently, of the Peritonæum.

The second Tunic is muscular, and consists of two Strata, one longitudinal, the other transverse; the Fibres of which have nearly the same irregular Direction with those of the Stomach: And this Disposition of the Fibres in the Viscera is owing to the different Diameters in the several Portions of them, and to their Incurvation.

These two Tunics are connected by a cellular Substance continued between the Vesicula and the Liver, all the Way to a whitish Stratum, which is looked upon as the third Tunic of the Gall-Bladder, answering to the Tunica Nervosa of the Intestines.

* Therefore, when we stand, the Vesicula Fellis lies in a Plane inclined a little from behind forwards; when we lie on the Back, it is almost inverted; when on the right Side, the Bottom is turned downwards; and it is turned upwards, when we lie on the left Side: And these Situations vary, according to the different Degrees of each Posture.

The interior or fourth Tunic has, on the Inside, a great Number of reticular Folds, filled with small Lacunæ, like perforated Papillæ, especially near the Cervix of the Vesicula, where these Folds are longitudinal, and afterwards form a kind of small Pylorus, with Plaits of the same Nature with those in the great one. These Lacunæ are looked upon to be Glands.

That Side of the Vesicula which lies next to the Liver, is connected to the Viscus by a vast Number of Filaments, which look themselves into the Substance of the Liver; and among these Filaments there are some Ducts * which form a Communication between the Pori Bilarii and Vesicula. They are most numerous near the Cervix of the Vesicula, and named Ductus Cyst-Hepatici, or Hepatico-Cystici.

The Cervix of the Vesicula is formed by the Contraction of the small Extremity; and this Cervix bending afterwards in a particular Manner, produces a narrow Canal named Ductus Cysticus. This Incurvation represents, in some measure, the Head of a Bird; of which the Cystic Duct, by the gradual Diminution of its Diameter, expresses the Beak. This cannot be seen when the Liver is extra Situm; and even in Situ it is but very imperfectly seen, when, in order to view the concave Side, the Liver is raised, and thrust too much against the Diaphragm: For by thus inverting the Liver, the Curvature is disordered, and we see two in the Place of one.

This Incurvation may be of Use to hinder too precipitate a Discharge of the Bile contained in the

* These Ducts have been observed in Brutes a long Time ago; and have been lately discovered in Men likewise.

† To see this Curvature in its true natural Situation, the Liver is to be raised but very little, and the Duodenum left untouched; then we must stoop, and look under the Liver, without moving any Thing.

Vesicula, which some Situations of the Body might occasion.

The Cervix of the Vesicula is nearly of the same Structure with the other Parts. It has, on the Inside, several reticular Rugæ, and some Folds, which appear like Fragments of Valvulæ Conniventes, situated very near each other, from the Cervix to the Contraction of the cystic Duct. The first of these Folds is pretty broad and large, and almost circular; the next is more oblique, and smaller in Size; and the rest diminish in the same Manner. Taken all together, they form a kind of spiral Flight, which may be seen through the Cervix on the Outside, where it sometimes appears like a Screw, especially when the Cervix is filled with any Fluid. This Observation is owing to HEISTER.

By flitting the Cervix and Duct, we see all these Folds very distinctly, especially when we examine them in clear Water: When they are viewed in any other Manner, they often deceive us; being mistaken for true Valves, because of their transverse Situation. They may, however, in some measure, supply the Place of Valves, by hindering the Bile from running too fast into the Duodenum, and the Contents of the Duodenum from entering this Duct.

The internal Surface of all these biliary Ducts, that is, those of the hepatic Cystic and Chole-dochus, which, being examined through a Microscope in clear Water, appear to be nearly of the same Structure through their whole Extent.

The cystic and hepatic Ducts do not, in their natural Situation, represent the capital Y of the GREEKS, where they form the Ductus Choledochus: After the Incurvation of the Cervix of the Vesicula, these two Ducts run very near each

other; and they appear to be separated only by raising up the Liver to view them. The same Disorder happens in an inverted Liver, extra Situm; for then the Body of the Liver subsides, is flattened, and thereby separates the Ducts: Whereas, in its true Situation, it is very much incurvated, and the Ducts come very near each other.

The Ductus Choledochus appears rather to be a Continuation of the Ductus Cysticus than the common Trunk of that, and of the Ductus Hepaticus: For I have observed, that this last Duct runs for some Space, within the Sides of the former, before it opens into the Cavity, much in the same Manner as the Ductus Choledochus passes into the Duodenum; and likewise observed, at the Opening of the hepatic into the cystic Duct, a small loose valvular Membrane, which may hinder the Bile from returning out of the Ductus Choledochus into the Hepaticus.

The Bile which passes through the Ductus Hepaticus into the Choledochus, may be called hepatic; and that which is collected in the Vesicula Fellis may be termed cystic. The hepatic Bile flows continually through the Ductus Choledochus into the Duodenum; whereas the cystic Bile flows only by means of Plenitude, or Compression.

Remarks on the Vessels, &c. of the LIVER.

The Trunk of the Vena Porta Ventralis terminates between the Lobulus and the opposite Part of the great Lobe, and there joins the Trunk of the Vena Porta Hepatica in the transverse Sinus of the Liver, between the right Extremity and the Middle of that Sinus.

The umbilical Ligament, and consequently the umbilical Vein, in the Fœtus, joins the Trunk of the Vena Porta Hepatica towards the left Extremity

mity of the transverse Sinus of the Liver. The Canalis Venosus in Man is not exactly opposite to the Vena Umbilicalis, but a little on the right Side; and therefore these three Vessels lie in such a Direction, as to form two opposite Angles.

In the Fœtus, therefore, the Blood which comes from the umbilical Vein does not run directly through that contained in the Vena Porta Hepatica, in the Sinus, and from thence into the Canalis Venosus; but is obliged to turn from Left to Right, and so to mix with the Blood in the Vena Porta, before it enters that Canal, which opens into the Trunk of one of the great hepatic Veins of the Vena Cava, near the Diaphragm.

The Hepatica Vena Porta gives off commonly five large Branches into the Liver; viz. three from its right Extremity into the great Lobe; two from its left Extremity into the small Lobe; and, from the Interstice between these, a small Branch goes directly to the Middle of the convex Side of the Liver.

The hepatic Veins are commonly three large Bunches of the Trunk of the Vena Cava Inferior, which go out from it by one common Opening, especially two of them; and then separating, they enter the Substance of the Liver, intersecting the Branches of the Hepatica Vena Porta, and are ramified, in all Directions, in the Manner already explained. The inferior Portion of the Opening of these Veins into the Vena Cava, forms a kind of semilunar Valve.

Below these hepatic Veins, the Vena Cava Inferior sends off, in its Passage by the Liver, several other small hepatic Veins immediately from the Trunk, which seem to have the same Relation to the hepatic Artery, as the great Veins to the Vena Porta.

The Passage of the Vena Cava is through the right Portion of the posterior Sinus of the Liver, and consequently on the Side of the great Lobe, which is sufficiently hollowed at this Place to give Passage to the Vein, of which it surrounds above three Fourths, sometimes more, and sometimes the Whole.

This Passage answers to the Interstice between the Lobulus and the rest of the great Lobe; and its Direction is, in the natural State, from above downwards, and a little from right to left; but when the Liver is viewed extra Situm, and inverted, it appears very oblique, but still serves as a Guide to Beginners, who are very apt to be mistaken in examining an inverted Liver, as I have already observed.

The Trunk of the great Vena Porta, the hepatic Arteries, the Ductus Hepaticus, or Trunk of the Pori Bilarii, and the Nerves of the Plexus Hepaticus, form all together a large Bundle, before they enter the Liver: The Trunk of the hepatic Vena Porta is in the Middle of this Bundle, the hepatic Arteries lie on the right and left Sides of this Trunk, the Nerves surround it on all Sides, and they communicate with the Plexus Mesentericus Superior.

Afterwards the first Branches of the Arteries, Nerves, and Pori Bilarii, leave the Trunk of the great Vein, and join, in the same Manner, the Trunk of the small or hepatic Vena Porta, and its Ramifications in the Capsula Glissoni, explained above.

All these Branches of the Vena Porta, and of the Arteries, Nerves, and Pori Bilarii, accompany each other, by Ramifications, through the whole Substance of the Liver; forming every-where small Fasciculi, in the same Manner as the large Bundle is formed by their Trunks. Each Ramus of the
Vena

Vena Porta, Artery, Nerve, and Porus Bilarius, has a proper Vagina; and all the four have a common Vagina, distinguished from the former by cellular Septa, which are only Continuations of the Vaginæ of both Kinds.

The convex Side of the common cellular Vagina is connected quite round, to the Substance of the Liver, by numerous Filaments which arise from it, and which form the cellular Substance found between the glandular Corpuscles. The concave Side produces the cellular Septa above mentioned.

In this common Vagina the Vessels, Ducts, and Nerves, are disposed in such a Manner, as that the Rami of the Vena Porta chiefly fill the Cavity of it, and is in a lateral Situation; the arterial Ramus and Porus Bilarius lie together on the Side of the Vein, and the Nerve is divided into several Filaments, which run in between the Vessels and Ducts, and chiefly accompany the Artery and Porus Bilarius, the Vena Porta having by much the fewest.

Disorders the LIVER is most subject to.

The Inflammation of the Liver is seated in the Extremities of the Ramifications of the Vena Porta, or hepatic Artery: And it is evident, from the Disposition of those Vessels, that an Inflammation, in either of them, must soon be succeeded by one or other.

The antecedent Causes of both these Species of Inflammation, are the same as the general Causes; but there are other local Causes, which relate more immediately to the particular Part: As an extraordinary Degree of Fatness in the Omentum may raise an Inflammation in the Liver, not only by compressing it, but also by the Dissolution of the
olea-

oleaginous Matter, either by Exercise, Getation, or Heat; and afterwards absorbed into the Veins, and conveyed to this Organ in too large Quantities, may occasion an Inflammation. This Disorder may also be produced by an atrabilarious Temperament of the Blood or Bile: For when such a Constitution is induced by an intimate Union of the Earth and Oil, with a Dissipation of the spirituous and aqueous Particles of the Blood or Bile; either of these Substances becomes the Subject of Concretion and Stagnation, in the minute Extremities and Branches of the hepatic Artery or Veins.

The Liver, likewise, suffers from Disorders in remote Parts of the Body: As if acrimonious Pus, Ichor, or a scorbutic Sanies, be deposited in any other Organ; these, upon the Accession of Heat, a Fever, violent Commotions, an improper Diet, ill-applied Medicines, or Poison, are colliquated, moved, and conveyed into the Blood, which are deposited in the Liver.

Besides these bad Effects, the Bile, when sanguineous, acrimonious, and exalted, or what the Antients named adust, if put in Motion by adequate Causes; a petrous, chalky Concretion, a schirrous Callus, Steatoma, Abscess, or Worms, occupying some Part of the Liver, Gall-Bladder, or biliary Ducts; upon the Accession of any Cause sufficient to put them in Motion, by the small Ramifications of the hepatic Vessels, excite therein an Inflammation.

Cold, also, applied to the Liver when, by any Means, over-heated, contracts the Vessels, and indissipates the Fluids, which produces an immediate Inflammation. Cold has much the same Effect, whether it is applied by means of the Air, Liquors drank, or Bathing. An Abstinence from diluting Liquors, during excessive Motion, great Heat, and

and profuse Sweating, will also cause an Inflammation in the Liver, &c. for when the Blood is deprived of its aqueous Particles, without a fresh Supply, it thickens, and stagnates in the capillary Vessels: Just as Abstinence from Drink, in burning Fevers, will produce a like Effect.

When it is only a simple Inflammation, the small Vessels are obstructed; hence a Tumor arises, which compresses the adjacent Parts, and, by that Means, propagates the Tumor to them: Thus it proceeds till almost the whole Organ is affected; which then compresses the Stomach, and is also compressed by it, when full. It likewise affects the Diaphragm, and sometimes excites Pain, and inflames that Part: Besides which, all the Blood received by the Cæliac Artery, and the mesenteric Arteries, is intercepted, and stopped at the Liver; and, in consequence of this, the Circulation of the Fluids of the abdominal Viscera are intirely obstructed: Therefore Secretion, Excretion, and the Circulation of the Bile, is hindered. Hence various Kinds of Jaundices are produced, with all ill Consequences; Putrefaction of the abdominal Viscera, &c.

From what has been said, concerning the Disorders of the Liver, many Symptoms, which occur in acute Distempers, frequently erroneously attributed to Malignity, may be clearly understood. For the State of all the abdominal Viscera, and their respective Actions, as Digestion, Assimilation, and Nutrition, recruiting the Blood with fresh Supplies, and the Expulsion of the Excrements, depend upon the Liver.

In this Organ there are three Sorts of Humours, which readily putrefy by Heat; that is, a thin Blood, in large Quantities; the cystic and hepatic Bile: It is farther observable, that the Situation of the Liver is such, as renders it very subject to affect

fect the Diaphragm and Heart; and that when the Extremities of the biliary Ducts are obstructed, the bilious Fluid is conveyed by the Vena Porta, and then has an easy Access into the Vena Cava. Hence the Nature of the Black Vomit (a Disease very frequent in the West Indies) may be better understood.

By considering all these Circumstances, we may arrive at an accurate Knowledge of the various Species of Jaundice; why it is that this Distemper is sometimes easily cured, and under what Circumstances; why it sometimes proves fatal very suddenly, and at other Times continues long before it destroys the Patient; why it sometimes comes on, remains, disappears, and returns, at certain Periods; why the Appearance, Cessation, and Return, of a Jaundice, are so frequently preceded by Anxieties, excessive Vomitings, Pain, and Convulsions; and therefore the Bile being prevented, in the large Ducts, from flowing into the Duodenum, why a Jaundice, appearing in an acute Fever, before the seventh Day, is a bad Presage; and why, after the seventh Day, it scarcely admits of a Cure: Why a copious Dysentery, of no long Continuance, effectually cures a Jaundice; why Bleeding affords but little Relief in Inflammations of the Liver; because the biliary Organs have not so immediate a Communication with other Parts of the vascular System, but form, as it were, a separate Circulation; why it is of so great Consequence, in acute Diseases, to examine the Tumors and Elevations of the Hypochondria*; why

* Mr. PETIT gives several Instances where the Gall-Bladder was so much distended with Bile, as to be mistaken for an encysted Dropſy and Abscess of the Abdomen, and for such was opened; which either destroyed the Patient, or left a fistulous Sore that could not be cured. And he acknowledges, that he once was in Danger of committing

why the Colour of the Eyes and Urine so readily indicate the Presence and Terminations of a Jaundice; why inflammatory, purulent, gangrenous and schirrous Disorders of the Spleen, Stomach, Epiploon, Mesentery, and Intestines, always affect the Liver in so violent a Manner; and why, on the contrary, inflammatory and schirrous Disorders of the Liver affect these Viscera; why the Liver is sometimes tumified, and augmented so prodigiously in Bulk; and why it is dried, and become friable, when the Fluids can no longer circulate through it: Why a Dropsy arises from Disorders of this Organ, and sometimes a Tympanum, of still worse Consequence. For when the bilious Particles are not secreted from the Blood, and by the Liver, these Particles attenuate the Blood so extremely, as to make it transude easily through the Vessels, and be accumulated in the Cavities of the Body; why, in a Dropsy, the Liver is so extenuated and dry, and the Spleen tumid: And, lastly, hence we see the Nature of an hepatic Dysentery, and an infinite Number of Circumstances relative to Diseases of this Kind. See BOERHAAVE'S Aphorisms.

OBSERVATIONS.

The Stomach hardly makes any Pressure upon the Gall-Bladder, only by the contiguous Beginning of the descending Duodenum; but when the Stomach is extremely distended, and in a very full

mitting such a Mistake. He had cut through the internal Teguments; and the Tumor beginning to subside, made him immediately suspect it to be the Gall-Bladder, and to desist from the Operation. Soon after the Patient voided, by Stool, several Pints of Bile, and was cured. He says, that such bilious Tumors may be distinguished by a painful Tension about the hepatic Region, followed by a Jaundice with all its Symptoms, and by the Situation of the Tumor itself; which Symptoms, he says, generally appear; and, when duly considered, will lead us to guess at the real Distemper. *Memoires de l'Acad. de Chirurg. Vol. I.*

Abdomen,

Abdomen, it makes a considerable Pressure both upon the Liver and Duodenum; by which the Gall-Bladder is urged, and its Bile expressed. Thus the Bile flows, through a free Passage, from the Gall-Bladder into the common Duct, and by that into the Duodenum; and this it does more easily in Persons lying on their Backs: In which Posture the Gall-Bladder does not flow back again into the Liver, appears from the Continuity of the Cystic and Ductus Choledochus, with the Angle that interrupts the Course from them towards the Liver, and the Resistance of the new Bile, advancing forward from the latter. The expulsive Force of the Bile is but little more than that of the Pressure received from the Stomach, Diaphragm, and abdominal Muscles: For as to any muscular Force residing in the Fibres of the proper Membrane, which may be thought to contract the Gall-Bladder, it must be very weak and inconsiderable. But the hepatic Bile continually flows this Way, even after the cystic Duct is tied, unless there happens to be some Obstacle at the Opening of the Ductus Choledochus, which seldom continues long. Nor is it credible that all the Bile first passes thro' the Gall-Bladder, in its Way from the Liver, before it enters the Duodenum: For there is no perpetual Obstacle or Resistance to turn the Bile towards the Gall-Bladder, out of its Course into the Intestine. For the Way into the common biliary Duct is larger, and more direct; but the cystic Duct, being a great deal less than even the hepatic, cannot therefore be designed for receiving all the Bile which Nature intended to flow through those so much larger Passages: Again, the Ductus Choledochus, being so much larger than either the cystic or hepatic, is, by the same Rule, designed to carry more than the Bile of either of them alone. In many Animals, the hepatic Duct conveys the
Bile

Bile into the Intestine, without any Communication with a Gall-Bladder, or a cystic Duct; and in other living Animals, where there is a free Communication with a cystic Duct, yet the Bile is found continually descending into the Duodenum. That the Quantity of Bile, so discharged, is very considerable, may appear from the Bulk of the Organ by which it is separated, as well as the Magnitude of its excretory Duct * so many Times exceeding that of the salival Glands; and from Diseases in which the Quantity of the cystic Bile only has, by an Ulcer of the Side, been let out equal to four Ounces at once.

The hepatic Bile is always bitter, but the cystic is more so; and both of them easily mix either with Water, Oil, or vinous Spirits, and are extremely well adapted to dissolve oily, resinous, or gummy Substances. It is inclined to Putrefaction; but, of itself, it naturally degenerates to a Musk-like Odour. Its chymical Analysis and Experiments of Mixture with various Substances, demonstrate, that it contains a large Portion of Water, but a much lesser of inflammable Oil, by near a twelfth Part; which, in Stones of a Gall-Bladder, appears very evidently; besides which, there is no inconsiderable Portion of a volatile alkaline Salt. The Bile, therefore, is a natural Soap; but of that Sort which is made from a volatile saline Lixivium. This, therefore, being intermixed with the Aliment, reduced to a Pulp, and slowly expressed from the Stomach by the peristaltic Force of the Duodenum, and Pressure of the abdominal Muscles, incorporates them all together; and the acid or acescent Qualities of the Food are, in some

* I have just now found the Pori Bilarii and hepatic Duct considerably larger than the Vena Porta; Hepatic and Vesicula Fellea less than this Duct.

measure, thus subdued ; the Curd of Milk is again dissolved by it into a Liquid, and the whole Mass of Aliment inclined more to a putrid alcalescent Disposition. Like Soap, it dissolves the Oil or Fat, so that it may freely incorporate with the aqueous Particles, and make up an uniform Mass of Chyle to enter the Lacteals ; the surrounding Mucus in the Intestines is hereby absterged and attenuated, and their peristaltic Motion is excited by its Acrimony ; all which Offices are confirmed, by observing the contrary Effects, from a Want or Defect of the Bile. Nor would the hepatic Bile of itself be sufficient to excite the necessary Motion of the Intestines, without the stronger Action of the Cystic, both which are of so much Use and Importance to the Animal, that we find, by Experiment, even the strongest will perish, in a few Days, if the Flux of Bile be intercepted to the Intestines, by wounding the Gall-Bladder.

Thus it slowly descends along with the alimentary Mass, and, having spent its Force, or changed its Bitterness by Putrefaction, most of it is afterwards excluded, together with the Fæces ; but, probably, some of the more subtil, watery, and less bitter Parts, are again taken up by the absorbing Veins, which lead to the Portæ of the Liver. It seldom returns up into the Stomach, because of the Ascent of the Duodenum, which goes under the Stomach, with the Resistance it meets with from the Valvulæ Pylori, and the Advancement of the new Chyle, to which add the Force of the contracting Stomach itself. The Bile is indeed of a sweet soft Nature in the Fœtus ; for in them the Fæces are not very fœtid, to supply putrid alkaline Vapours to the Liver ; nor are there any oily or fat Substances absorbed from the Intestines.

As the Bile is a viscid Fluid, and thickens by Inactivity of Body in fat Animals, and in us from
the

the same Causes, especially when the Blood moves languid from Grief, &c. so it easily coagulates into a hard, somewhat resinous, and often stony Substance; insomuch that Stones of the Gall are much more frequent than those of the urinary Bladder. When the excretory Passages are obstructed by this Cause, or by a contrary convulsive Motion in the Ducts of the Liver, the Bile is, without much Difficulty, urged again into the Blood, which passes the Capillaries of the Porta into the Cava, as the Way is so pervious; whence all the Humours, and the mucous Body of MALPIGHI, become tinged with its Colour, which forms a Jaundice. Whether or no the common biliary Duct is ever truly inserted into the Pylorus. This, indeed, is an Observation published in the more uncultivated Ages of Anatomy, the Tradition of which has not been favoured by any of the more modern Anatomists; although we sometimes read of its being inserted near to the Pylorus. HALLER's Prim. Lin. Physiol.

OBSERVATION.

I know no Way of computing, with any Exactness, the Quantity of Bile that is usually secreted by the Liver in a given Time: But if it is four Times as much as all the salivary Glands secrete, it may be twenty-four Ounces for every Meal; to which being added six Ounces of Saliva, I think this will appear a moderate Computation: And supposing the Pancreas, in the same Time, secretes three Ounces, there will then be

* In opening the Body of a Woman of a very good Habit, I found, in the Vesicula Fellis, the Bile concreted to the Bulk of a large Olive, of a mineral Colour; which was looked upon, by the ROYAL SOCIETY, to be the largest Concretion ever known to have been found in the Vesicula Fellis.

thirty-three Ounces of Fluids separated for the Digestion of one Meal; and that these necessary Fluids may not be wasted in such Quantities, they pass into the Blood with the Chyle, and may be soon separated again for the same Use; and, very likely, some of the same Bile may be employed, more than once, for digesting Part of the same Meal. And as the Liver exceeds all the Glands, in the Body, in Magnitude, and its excretory Ducts ending in the Duodenum; it seems to me to be much more capable of making those large Separations from the Blood which are procured by Cathartics, than the scarce visible Glands of the Guts. The Liver ordinarily weighs, in a middle-sized Man, about three Pounds twelve Ounces, the Pancreas three Ounces, and the Spleen fourteen Ounces.

I have seen a diseased Liver, in a Man, which weighed fourteen Pounds, four Ounces; and in a Boy but nine Years old, who died hydropic, the Liver full of Hydatids, and Cysts of Hydatids adhering to it, which, together, weighed seven Pounds, one Ounce and a Half, though several Pints of Water had been let out of it before. The Spleen in the same Boy, together with the Hydatids contained in its Membrane, weighed three Pounds.

In a Man I found a diseased Spleen, weighing five Pounds, two Ounces; and in an old Man, six Feet high, I found a sound Liver weighing no more than twenty-eight Ounces, and the Spleen but ten Ounces: And in a Man, who had been cured of a Dropsy, I found a Polypus very solid, almost filling the large Branches of the Porta in the Liver, and a Stone, between the Liver and Gall-Bladder, larger than a Nutmeg. CHESELDEN'S Anatomy.



LECTURE VIII.

Of the PANCREAS.



THE Pancreas is a long flat Gland, of that Kind which Anatomists call Conglomerate, situated under the Stomach, between the Liver and the Spleen. Its Figure resembles that of a Dog's Tongue, and it is divided into two Sides, one superior, the other inferior; two Edges, one anterior, the other posterior; and two Extremities, one large, which represents the Basis of a Tongue; and one small, and a little rounded, like the Apex of a Tongue.

The Pancreas is situated transversely under the Stomach, in the Duplication of the posterior Portion of the Mesocolon. The large Extremity is connected to the first Incurvation of the Duodenum, and from thence it passes before the rest of that Intestine, all the way to its last Incurvation; so that a great Part of the Duodenum lies between the Pancreas and the dorsal Vertebrae. The small Extremity is fixed to the Omentum, near the Spleen.

Structure of the PANCREAS.

The Pancreas is composed of a great Number of soft glandular Moleculæ, combined in such a Manner, as to exhibit the Appearance of one uniform Mass on the Outside, the Surface of which is rendered uneven only by numerous small Convexities, more or less flattened. When these Mole-

culæ are separated a little from each other, we find along the Middle of the Breadth of the Pancreas a particular Duct, in which several smaller Ducts terminate laterally, on each Side, like small Rami, in a Stern.

This Canal, named *Ductus Pancreaticus*, or *Ductus Wirtfungi**, from the Discoverer of it in the human Body, is very thin, white, and almost transparent; and the Extremity of the Trunk opens commonly into the Extremity of the *Ductus Choledochus*: From thence it diminishes gradually, and terminates in a Point next the Spleen; the small lateral Branches are likewise pretty large near the Trunk, and very small towards the Edges of the Pancreas, all of them lying in the same Plane, like the Branches of the common Filix, or Fern.

The pancreatic Duct is sometimes double in Man, one lying above the other: It is not always of an equal Length, and sometimes runs in a winding Course, but always in the same Plane; and it is nearer to the inferior than the superior Side of the Pancreas. It pierces the Tunics of the Duodenum, and opens into the *Ductus Choledochus*, commonly a little above the prominent Point of the Orifice of that Canal; and sometimes it opens immediately into the Duodenum.

PANCREAS MINUS.

In Man I have observed, that where the great Extremity of the Pancreas is connected to the Curvature of the Duodenum, it sends down an Elongation, which adheres very closely to the following Portion of the Intestine; and, upon a careful Ex-

* GEORGE WIRTSUNGIIUS, who first discovered this Duct in the Year 1642. which caused such Animosity among other Anatomists, that he was shot in his own Chamber.

amination, I found a particular pancreatic Duct, ramified like the large one, which ran towards, and intersected this great Duct, into the Extremity of which it opened, after having perforated the Duodenum. This Portion I term Pancreas Minus; and it sometimes opens separately into the Duodenum; in which we likewise observe several small Apertures, round the Ductus Choledochus, which answer to the Pancreas.

SANGUIFEROUS VESSELS and NERVES of the PANCREAS.

The Arteries of the Pancreas come from the Pylorica, Duodenalis, and chiefly from the Splenica, which adheres very closely to the whole inferior Side of the Pancreas near the posterior Edge; and it sends off, in its Passage, a great many Rami, named Arteriæ Pancreaticæ, which go off from each Side, more or less transversely. It receives also some small Ramifications from the Gastrica Major and Mesenterica Superior.

The pancreatic Veins are Rami of the Splenica, one of the principal Branches of the Vena Porta Major, or Ventralis. This Vena Splenica runs, likewise, along the inferior Side of the Pancreas, near the Edge, in a shallow Depression formed in the Substance of the Gland. These Veins answer to the Arteries of the same Name; and there are likewise other small Veins, corresponding to the small Arteries, which are Productions of the Mesaraica Major, &c.

The Nerves of the Pancreas come partly from the Plexus Hepaticus, partly from the Plexus Splenicus, and partly from the Plexus Mesentericus Superior; and it likewise receives some from the flat ganglion or plexiform Intertexture mentioned in the Description of the Nerves, and called by the Name of the Transverse Branch.

The pancreatic Duct is not only double in some Subjects, as has been said before, but the collateral Branches have Communications, in Form of Islands, in several Places within the Body of the Pancreas.

JUICE of the PANCREAS.

This Juice may cause many Indispositions.

1. If it remains too long in the Pancreas, it will alkalize, as all the Fluids of the human Frame.
2. If it is too abounding, it will retard the Action of the Bile; and therefore the fat Substances will not be able to dissolve.
3. If it is obstructed, the Bile will be too acrimonious, heat and rarefy the Air, and be able to cause Diarrhæas and Dysenteries.

It was formerly believed, that the Cause of intermittent Fevers was in the Pancreas; and the Opinion was grounded on its having been found, that this glandular Body was obstructed in Subjects who died of these Fevers: But it should have been proved before, that these Obstructions were not the Effect of Fevers. Certainly an obstructed Pancreas may be the Occasion of considerable Disorders: We may judge of it by the Quantity of Fluid which is there filtrated, and by its Necessity in Digestion. If the excretory Ducts be so closed as to permit no Fluid to go out, the Vessels will be more filled in the rest of the Body, which may inflame the Pancreas; on the other hand, the Duodenum will no more receive the Fluid which is necessary to dilute the Chyle, and precipitate the Excrements.

OBSERVATIONS.

The Quantity of Juice secreted by this Gland is uncertain; but it must be very considerable, if we compare the Bulk or Weight of it with that of the salival Glands, than which it is three Times larger,
and

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and seated in a warmer Place. It is expelled, by the Force of the circulating Juices, with an alternate Pressure from the incumbent and surrounding Viscera; as the Liver, Stomach, Spleen, mesenteric and splenic Arteries, with the Aorta. The great Usefulness of this Gland may appear, from its being found not only in Man, but in most Animals; nor is its Use the less, from that Experiment which shews that a great Part of it may be cut out from a Beast, unattended with any fatal Consequences: For, by that Rule, the Animal, surviving after a Part of the Lungs are cut out, would render them equally useless; and besides, in the Experiment, a Part of the Pancreas must be left with the Duodenum.

As to this Juice making any Effervescence with that of the Bile, that Notion has been so long exploded, as to need no farther Notice. HALLER.

MAURICE HOFFMAN first discovered an excretory Duct, composed of a Number of others, in the Pancreas of a Turkey, in 1641; and afterwards it was discovered by WIRTSUNGIUS in the human Body; as BARTHOLINE, who was present, informs us. This Duct is commonly single in the human Body; sometimes, however, it is double. In many of the common Birds it is double, and in some triple. Its Situation is in the Middle of the Pancreas, where it resembles an empty Vein, and is of about the Thickness of a small Straw. Its Termination is in the Duodenum. It enters it obliquely, four or five Fingers Breadth below the Pylorus, usually at the same Orifice with the Ductus Choledochus; but sometimes it has a double Aperture. In many Beasts it is inserted into the Duodenum, by a particular Orifice, at a considerable Distance below the Pylorus.



LECTURE IX.

Of the SPLEEN.



THE Spleen is a bluish Mass, somewhat inclined to red, and of a long oval Figure; being about seven or eight Fingers Breadth in Length, and four or five in Breadth. It is of a softish Substance, and situated in the left Hypochondrium, between the great Extremity of the Stomach and the adjacent false Ribs, under the Margin of the Diaphragm, and above the left Kidney.

It may be naturally divided into Sides, Edges, and Extremities. It has two Sides; one external, and gradually convex; and one internal, which is irregularly concave: Two Extremities; one posterior, which is pretty large; and one anterior, which is smaller, and more depressed: Two Edges; one superior, and one inferior; on both which there are, in some Subjects, several Inequalities.

The interior or concave Side is divided, by a longitudinal Scissure, into two Planes or Semilaterals, one superior, the other inferior; and by this Scissure, the Vessels and Nerves enter in human Subjects. The superior Semilateral is broader and more concave than the inferior; being proportioned to the Convexity of the great Extremity of the Stomach. The inferior Semilateral

lateral lies posteriorly on the left Kidney, and anteriorly on the Colon; and sometimes this Side of the Spleen appears to have two superficial Cavities; one answering to the Convexity of the Stomach, the other to that of the Colon: The convex Side of the Spleen is turned to the left Ribs.

It is connected to the Stomach by the Vessels called *Vasa Brevia*; to the Extremity of the Pancreas by Ramifications of the splenic Artery and Vein, and to the Omentum by Ramifications which the same Artery and Vein send to the Spleen, and which run in the longitudinal Scissure.

It is connected to the Margin of the Diaphragm by a particular membranous Ligament, of various Breadths in different Subjects, fixed on its convex Side sometimes near the superior Margin, and sometimes near the inferior.

This Ligament is situated transversely with respect to the whole Body, and longitudinally with respect to the Size of the Spleen: In some Subjects it is connected, by other Ligaments, to the Stomach and Colon; but in this there are considerable Varieties.

The Figure of the Spleen is not always regular, but is as various as its Size: Sometimes it has considerable Scissures, both in the Sides and Edges; and sometimes it has Appendices. I have sometimes found a kind of small distinct Spleen, more or less round, and connected separately to the Omentum, at some Distance from the anterior Extremity of the ordinary Spleen.

Structure of the SPLEEN.

This is not easy to be unfolded in Man; and it is very different from that of the Spleen in Brutes.

Its Coverings adhere so closely to it in Man, that it is difficult to distinguish the common from the

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the proper Membrane; whereas in some Brutes, such as Oxen, Sheep, &c. nothing is more easy: For in such Animals we find two Membranes, separated by a cellular Substance. This Covering seems to be no otherwise a Continuation of the Peritonæum than by the Intervention of the Omentum and Mesocolon; and even in Man, the two Membranes may be distinguished, where the Vessels enter by the longitudinal Scissure.

In Man, the Substance of the Spleen is almost vascular, that is, composed of the Ramifications of all kinds of Vessels: In Oxen, the Substance of the Spleen is chiefly reticular; and in Sheep, it is cellular. In Oxen and Sheep, there are no venal Ramifications, but, instead thereof, only open Sinuses, disposed like Branches, except a small Portion of a venal Trunk, perforated on all Sides, at the Extremity of the Spleen.

In the human Spleen we see somewhat like glandular Corpuscles, as in those of other Animals; and there are numerous venal Ramifications thro' its whole Extent: Between these Ramifications we every-where observe an Appearance of extravasated Blood, lying in a kind of filamentary transparent and very delicate Substance expanded through the whole Spleen.

This filamentary Substance, having surrounded all the Ramifications, terminates in almost imperceptible Cells, which communicate with each other so, that if we blow through a small Aperture, made in the membranous Covering, the whole Spleen will be immediately inflated.

The Surface of the Spleen of Oxen and Calves is visibly full of a great Number of lymphatic Vessels, which may, at any Time, be easily demonstrated; but in Man, it is a very difficult Matter either to discover or demonstrate them.

SANGUIFEROUS VESSELS and NERVES of
the SPLEEN.

The splenic Artery, which is one of the principal Branches of the Cæliaca, runs along the inferior Side of the Pancreas, as has been already said, and passes from thence, in a winding Course, to the Spleen. The splenic Vein, which is larger than the Artery, is but little inflected in this Part of its Course.

This Artery and Vein, having got beyond the Extremity of the Pancreas, send out several Rami together, which immediately afterwards divaricate in the same Plane, run in the membranous Duplication of the neighbouring Portion of the Omentum, and, lastly, intersect each other, in their common Plane, all the Way to the Scissure of the interior or concave Side of the Spleen.

These arterial and venal Rami enter the Substance of the Spleen, together, by the same Scissure; being accompanied by the cellular Substance belonging to the membranous Duplication of the Omentum. We may likewise observe, that at this Place the Membrane of the Spleen sends from its concave Side a Portion of a Lamina, which is incurvated in the Scissure, and penetrates into its Substance.

The Nerves * of the Spleen are very numerous, and come from the Plexus Splenicus, already described: These Nerves send out, at different Distances, round all the arterial Ramifications of the Substance of the Spleen, a great Number of Filaments in Form of an irregular reticular Texture.

The Arteries, Veins, and Nerves, having entered the Spleen, are there divided and subdivided

* They are so very small, that they are capable of but little Sensation; therefore rarely inflamed. Vid. HALLER's Phytolog.

into a great Number of Ramifications, and accompany each other to the very Extremities of their Divisions. They are contained in a kind of common cellular Capsula or Vagina, which first surrounds all the three, and then sends off particular Septa between them. This Capsula seems to be formed by a Continuation of the cellular Substance of the Omentum, and of that particular Lamina of the Membrane of the Spleen before mentioned.

The capsular Extremities of all these vascular Ramifications, both arterial and venal, end in the filamentary Cells already mentioned. MALPIGHI considered them as distinct Capsulæ or Folliculi, containing the same Number of small Glands: They all communicate together so, that wherever we pierce the Membrane of the Spleen, we may, through that Aperture, inflate the whole Viscus.

In Oxen and Sheep there are no venal Ramifications, as I have said. The Vena Splenica, having entered the great Extremity of these Spleens, runs first of all for about Half an Inch or an Inch, and afterwards, instead of an ordinary Vein, we find a Canal perforated on all Sides. The Beginning of this Canal has still some Remains of the Coat of a Vein; but the Form of it is soon lost, and then we find nothing but Sinuses, or Sulci, in the reticular Substance in Oxen, and in the cellular Substance in Sheep.

The splenic Artery and Nerves are there ramified in a particular Vagina, as in Men; and the Extremities of these arterial Ramifications seem to swim or float in the Cells, and to fill their filamentary Substance with Blood. At the Ends of several of these Capillaries I have observed small Corpuscles, disposed like Bunches of Grapes; and I have seen two small Tubes going out from each Corpuscle, one long and open, the other small and short, which was lost in the Sides of the Spleen.

I imagine that the long Tube, the Extremity of which I was not able to find, may be the Origin of a lymphatic Vessel, especially because these Vessels are so very numerous and visible in an Ox's Spleen, as has been already said. These small Corpuscles may easily be discovered in an Ox's Spleen, when boiled by a particular Administration, of which I shall say more in another Place. They are indeed much larger before than after boiling, but they are not so solid, and subside more easily when cut. The same Sort of Corpuscles may be discovered in the human Spleen; but they are so extremely small, as not to be visible without a Microscope.

Various Conjectures on the Use of the SPLEEN.

Since the Spleen seems to be subservient to the Liver, we shall now examine the Uses of it. It has been looked upon, for a long Time, as an unprofitable Part, which Nature had placed, in the left Hypochondrium, as a Counterpoise to the Liver. Perhaps they*, who have succeeded, have been confirmed in this Opinion, from what PLINY relates, upon the Credit of his Cotemporaries.

This most eloquent Naturalist assures us, that the Spleen is a great Hinderance to Running; but by several Experiments, made since his Time, by taking it away from several Animals, this Error has been detected.

A famous Practitioner† boasts, that he took away from a Woman a Spleen which weighed two Pounds. Another‡ says, this Operation was performed, in his Time, by two Surgeons; who assured him, that they were obliged to take away the Spleen from two Persons who had received a deep

* DEMOCRIT. ERASISTRATUS, RUFFUS, EPHESIUS, &c.

† FIORIVENTI.

‡ ROUSSET.

Wound in the left Hypochondrium, by which the Spleen came out. The like Instances are to be met with in the Works of other practical Writers *. Besides, it is known, that Dogs, after the Spleen is taken away, are cured in a short Time; and that they grow fatter, and are always eating; piss often, and follow the Bitches also more eagerly. This Operation having been made on two Dogs, they opened them, six Months after, and the Bile was found to be like coagulated Milk. The same has also been observed in Dogs whose Spleens were not taken away. Though Animals are cured, in a short Time after the Spleen has been taken out of them; we must not thence conclude, that it is useless. Is it not well known, that the Testicles, Omentum, &c. are taken away, without Danger, or Risque of the Animal's Life? The particular Structure of the Spleen, the Connection it has with other Viscera, and the Indispositions which it causes, when disordered, sufficiently convince us, that it is of great Use in the Body. It is long since it was known † to be no Parenchyma: The Substance of it is only a Heap of Fibres and little Cells, like those in a Bee-hive. These little Cells are made by the Ramification of the venal Duct, as the little Vesicles of the Lungs are formed by the Branches of the Aspera Arteria, which are thin and slender. Some have observed, that there are certain small Glandules, which fill up these little Cells of the Spleen, that they sometimes lie in Heaps close to each other, but are also often separated from each other; the Branches of the Arteries and Veins are sensibly dispersed there; they are lesser in Man than in Sheep; and yet, in a Calf, they immediately appear, as soon as the Membranes are taken

* The German Journals, and Dr. BONET.

† Vid. VESALIUS, HIGHMORE, GLISSON, and MALFIGHT.

away; and that the Spleen is well washed by syringing the two Vessels.

It is well known, that the Spleen has no excretory Duct: There are a Million of little Branches from the Trunk of the Arteria Splenica, which form a kind of reticular Texture in the Spleen: Some go to the Glandules, and to these Coverts or Cafes: In fine, there are also others which empty themselves immediately into the venous Sinus.

It is difficult to trace out these Branches even to the Glandules. An Injection goes a great Way into the more sensible Ramifications; but it passes no farther. But Reason tells us, that there must be some Communication between the smallest Branches and the Cellulæ: For the Spleen having no excretory Duct, all the Blood which passes into this Part, or Viscus, must needs be immediately poured through the Branches of the Arteries into all the Cellulæ. And it is not only the more subtil Liquors which may pass into these little Cells, but also Wax, by syringing the Arteria Splenica, upon the Supposition of this Structure. I hope it will appear no longer a Paradox, that the Arteria Splenica is so much bigger than the Arteria Hepatica; because the Blood, which passes to the Spleen, is not poured into small Spaces, as it is in the Liver; but it enters into a great many Cellulæ, which being collected, would make a large Cavity. Therefore the Spleen required a larger Duct than the Liver, that it might receive more Blood.

The Arteria Splenica has always a Vein with it, but there is no Anastomosis betwixt these Vessels, as many * Anatomists have said. They are all covered with a Capsula, through which the two Nerves, which belong to each Branch of the Ar-

* BARTHOLINUS, HIGHMORE, and DIEMERBROECK.

tery, pass, which are also insensibly spread through the Spleen.

The Spleen is a Viscus which is very subject to Obstructions; because, being altogether of a spongy Substance, the Blood may easily enter there. If the Return of the Blood is any ways hindered, an extraordinary Pulsation in the left Hypochondrium may very sensibly be perceived.

Practical Authors * have many Instances of this Kind. It is sometimes attended with Vomiting, and evacuating Blood also by Stool.

A Man was dissected who was thought to be poisoned, having died, in a short Time, of an extraordinary vomiting of Blood. The Ventricles of the Heart and Vasa Major had no Blood in them; on the other Side, the Stomach and Intestines were full of it. The outward Membrane of the Spleen was hard and callous, but the Substance of it was very soft; there was no Blood found in the little Cells of it. In fine, they found all the Liver schirrous, which caused a Conclusion to be drawn that he was not poisoned, but that he died of the rising or ascending of the Blood into the Arteria Splenica, which was occasioned by the Schirrus of the Liver.

As to the lymphatic Vessels of the Spleen, we shall observe, that they do not run through the Membrane, but enter into the Substance of it as far as the small Glandules. It is impossible to pursue or trace out the Progress of them, either by Dissection or Injection; because the Blood, which flows from the Vessels, happening to be lacerated on this Occasion, hinders us from inspecting them.

The Spleen has been looked upon, by some, as the Source of Melancholy; others have said that it

* TULPIUS Sepulchretum BONET.

served to separate some kind of laudable Liquor. The first who will have it that the Spleen separates the more terrestrial and gross Particles of the Blood from the other pretend, that these Impurities are retained by the Substance of it. This Opinion is easily confuted: For the Blood, which passes to the Spleen, is no way different from that which circulates to other Parts. Besides, when they assert that the Spleen is the Seat of Melancholy, it may be asked, Where is the Vessel to contain it? Is the Spleen a Vessel, like the Bladder, wherein the Gall is contained? We cannot say that the Vasa Brevia, and the hæmorrhoidal Veins, are the Sink for receiving this Excrement; since these short Vessels serve for nothing else but to bring and carry back the Blood. As to the hæmorrhoidal Artery; since that is only a Branch of the inferior Arteria Mesenterica, it would be ridiculous to make it the excretory Duct of Melancholy.

Others have imagined, that the Canalis Pancreaticus was the excretory Vessel of the Spleen. Some of the Moderns have ascribed this Office to the lymphatic Vessels. As to this Melancholy, so much insisted on by the Antients; we know not, as yet, what Idea they had of this Word; since there is nothing terrestrial in the Spleen; and that the Blood, which comes there, is like that of the other Parts, as was before observed. Besides, those * who pretend that the Spleen serves to separate some useful Juice or Liquor, are as much mistaken as the others, whether they agree with some, that the Spleen makes the Blood; or with others, that it prepares an Acid for Digestion.

The Followers † of ARISTOTLE, in this Point, are very numerous: They have all looked on the

* ARISTOTLE, ARITAUS, HELMONT, and WALÆUS.

† BAUCHINUS, PLATERUS, SPIGELLIUS, and CASP. HOFFMAN.

Spleen as a second Liver, which served to make Blood.

An eminent Author sets forth all their Reasons more at large, and adds others, which we have answered, by shewing the Absurdity of this Theory. As to that Opinion * about the Acid of the Spleen, it contradicts Experience; since we find those Animals, which have been deprived of their Spleen, have a better Appetite and Digestion.

There are others † who assert, that the Spleen perfects the Blood by communicating certain Spirits to it, as it passes into this Part. They say also, that the prodigious Number of Nerves which are ramified in the Spleen, by the several Turnings or Windings which they make, produce abundance of Spirits, which, by mixing with the Blood, do exalt and ferment it; whence the Chyle is the sooner turned into Blood. This Opinion is confuted by Experience; since it is not certain that the Nerves convey any Juice: Besides, we shall make it appear that the Use of the great Number of Nerves in the Spleen was unknown to them. For the Reason why there are such great Ramifications in the Spleen is, to prevent the Blood's remaining too long in those little Cells, with abundance of animal Spirits; whence their Spring is strong enough to drive out the Blood from those venal Cavities.

In fine, it has been said, that those Dogs, whose Spleens have been taken from them, are more brisk, nimble, hungry, piss oftener, and are also more eager after Bitches, than others; which indicates, that it is not the Spleen which contributes to the Acidity of the Blood.

* HIGHMORE and MALPIGHI.

† SYLVIUS, DE LA BOE, & VELTHUPIUS;

DENNIS, in his *Dissertations*, which he presented to the Dauphin, says, that the Spleen serves to thicken the Blood, and give it a certain Consistency, which prevents its being too precipitate in its Course, or being too subtil. But as he does not discover the Cause of the too great Effervescence of the Blood, we see no Necessity for its being condensed.

To say something, at present, that may be more satisfactory, on the Use of the Spleen, we shall first set down the Opinion of MALPIGHI, which he delivers only as a Conjecture which came into his Head. After the Examination of this Part, he says, that it is very probable, that the Blood, which passes into the Spleen, may there receive some Alteration, which may make it somewhat different from what it was before it came there; because it passes not into the Spleen after the same Manner as it does into the other Viscera, in crossing through the little Tubes, and small Cells, which form the capillary Branches of the Veins and Arteries. But the Blood which circulates in the Spleen, after it has passed through the Arteries and Glandules, is received into the larger Sinuses or Cavities, and greater Cells; where, by its staying there some Time, it is so modified, as to be able to change the Blood which it meets with in the Vena Porta; so that the Blood, which is distributed in the Liver, is better disposed to be secreted, in order to supply Matter for the Bile.

There are some who pretend, that there is a Communication between the Spleen and the Liver, from this; that, after the Spleen is taken away, the Liver grows bigger. This Phænomenon is not always true; since the Liver does not constantly increase in those Dogs which have been deprived of their Spleen. If the Liver has sometimes been found bigger upon the Extirpation of

the Spleen, it is not because the Arteria Hepatica, in that Case, did carry more Blood into the Liver.

Another Observation, which is more certain and important than the first, and which shews that there is a Communication between the Spleen and Liver, is, that the Bile is always found coagulated, in the Vesicula, the next Day after the Spleen is taken away: Hence we may infer, that the true Use of it is, to dispose the Blood so, as to be more easily separated in the Liver, for the Formation of the Bile. Yet here arise two Difficulties, which may be objected against this System. 1. Some, perhaps, may say, that, after the Spleen is taken out of a Dog, the Bile is strained in the Liver as it used to be. 2. That the small Quantity of Bile in the Glandules of the Vesicula is not derived from the Blood of the Ramus Splenicus; since that has no farther Communication with the Vesicula. We answer the first Difficulty by saying, that though it be true that the Bile is secreted in the Liver, as before described; yet this may proceed from another Cause; viz. that there is more Blood derived there, when the Spleen is taken away; and this Abundance of Blood may supply the Defect of this Part, which would have given the Blood the Alteration it usually receives.

It is also from this great Quantity of Blood that Animals, which have lost their Spleen, do piss so often, and are more greedy and salacious than others. For as there passes a greater Quantity of Blood through all the Viscera, the Secretions of it are much more copious; therefore the Dissolvent of the Stomach, which is nothing else but a Lympha filtrated through the Glandules of the Membrane, is more plentiful. The Testicles also must needs secrete more Semen, and the Kidneys more Urine. The Case is the same with the rest of the Glands, where the Spleen still remains.

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One may, in a Manner, observe the same Changes after drinking freely ; which proceeds purely from Fulness of the Blood, which is plentifully secreted through the Glandules, being overloaded with Serosities. The other Difficulty is easily answered ; since the arterial Blood, though there were no Spleen at all, is also secreted in the Liver, as well as the Lympha is in the Glandules of the Vesicula Billis.

The greatest Portion of the Blood, which passes into the Spleen, is received into its little Cells ; and a small Quantity of it secreted through the Glands. As the greatest Part of the Blood passes not thro' narrow Channels, but is poured out into large Spaces ; it remains some Time in those little Cells before it circulates : So this Return of the Blood not any-ways answering the Impulse of the Heart and Arteries, perhaps a fourth Part of the Blood is not driven from the Spleen at each Pulsation of the Heart. Thus we see, that, before all the Blood leaves the Spleen, many Pulses are required. During all these Intervals, the Blood, which remains in the Cellules of the Spleen, must undergo some Alteration, but not by Secretion, as the Spleen does not secrete any Liquor, not having excretory Ducts, at least not yet discovered. If it so happens, that the Blood is any ways changed in the Spleen, it is because, being of a spongy Nature, it is there squeezed, as in a Sponge ; as the Cellules of the Spleen are not always of the same Bigness. Since they often change their Figure, because they are formed of certain Membranes which have a great Number of Nerves spread all over them, which puts them continually in Action.

The glandulous Parts of the Spleen make no particular Secretion, as MALPIGHI says ; who believes, that they filtrate a brackish Liquor, which is mixed with the Blood of the Cellules, in order

to dissolve it, by which it is better disposed to leave its bilious Particles in the Liver. But as the Glandules of the Liver have no excretory Ducts, they differ no ways from other conglobular Glandules. Their true Use is only to secrete the Lympha, which returns by the lymphatic Vessels, into the Receptaculum Chyli, if these Glandules should secrete any acid Juice, as some imagine; it would rather coagulate than dissolve the Blood; since Experiments demonstrate, that Acids coagulate Blood, Milk, &c.

There are some Persons of Credit who say, they have extracted, by way of Analysis, an acid Salt from the Spleen. If that be true, we must suppose that the Fire had produced it, by changing the Particles of the mixed Substance; which proves that the Salt was not one of the Principles of the Spleen. Is this what they maintain? That this Salt being put into Blood, or Milk, coagulates them; yet the Spleen, being infused in Milk, does not coagulate, nor even when boiled in it.

In short, to make an End of our Conjectures on the Use made of the Spleen; many Experiments confirm what we have said, in the Spleens of all the living Animals which have been examined; the Blood of which was never found to be thick, or viscous; but, on the contrary, rather more fluid and thinner, than in any other Parts of the Body.

If we make a Ligature at the Vena Splenica, and take Care not to tie the Artery, and afterwards put the Spleen in its Place again, and sew up the Wound; in about two Hours after, if we take the Spleen out again, we shall find it full of a lively red Blood, provided the Animal be still living. This fine scarlet Colour returns pure into the Blood, because it cannot get out of these little Cellules of the Spleen: It is so strongly pressed, that the Particles of it are violently turned about
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their Center with a circular Motion; and the Blood, which the Arteries drive thither afresh, makes the Blood also turn round in the Spleen; because, by entering all at once, and not being able to get out; all these Particles beat against one another, as they pass from these little Cells to others; this makes them also turn, with a rapid Motion, just in the Manner as the Blood which passes into the Cellules of the Lungs, by its circular Motion; which renders it so red.

The Blood, which is taken from the Spleen, remains, for a considerable Time, of a florid Colour, fluid, and is a longer Time before it coagulates, or the Lympha is separated from it; and proves very sweet to the Taste: On the contrary, that Blood, which is taken from the Vein, is presently coagulated; and, in less than an Hour's Time, the Serum is separated from it. VERDUC on the Uses of the Parts of the human Body.

Now the most commonly received Opinion of the Fabric of the Spleen appears to be much more simple than has been commonly believed: For it is composed, both in Man and Calves, altogether of Arteries and Veins; the former of which, after spending themselves in a great Number of small Branches, are at length thickly subdivided into very soft Brush-like Bunches, very difficult to fill by Injection; terminating in Circles, by which there is a ready Passage for Liquors into the corresponding Veins. These Circles, with their parallel Branches, form a sort of Bunches like a Pencil Brush, but of a shorter rounder Kind; whence many have mistaken them for Glands. Nor does the Injection, rightly managed, ever escape from the Vessels into the cellular Substance; besides which, there are no other Cells or Intervals. Every little arterial Trunk, with the small Twigs which proceed from it, are each of them surrounded

rounded by a very fine cellular Substance, in the same Manner as the small Vessels of all the other Viscera ; and these, together, form the whole Substance of the Spleen, surrounded by a thin Membrane, which is a Continuation of the Peritonæum.

Hence we observe, that the Spleen contains more Blood, in Proportion, than any of the other Viscera ; since it has no Muscles, Fat, Air-Vessels, or excretory Ducts, interposed betwixt its Blood-Vessels. We learn, also, from Observation, that the Blood of this Part hardly ever congeals ; from the Abundance of its volatile or bilious Salts : But it looks of a dark brown Colour, and may be easily diluted ; whence one may compare it almost to the Blood of a Fœtus.

The Want of an excretory Duct to the Spleen, has occasioned the Use of it to be doubtful, and controverted throughout all Ages of Anatomy. To us the Fabric itself seems to lead to the Use following : We see by the Vessels a greater Quantity of Blood is imported to the Spleen, and with a slower Motion, from the serpentine Course of the Artery ; but, at the Time when the Stomach is empty, this Blood comes, and is reckoned in a greater Quantity, by the Spleen, not now so much compressed, therein to stagnate, as it would seem, plainly from the great Proportion of Branches, to the Trunks in this Part ; to which add, the difficult Course, or slow Circulation, which the Blood meets with in passing from the Spleen through the Liver. From hence the frequent Tumors and Schirrosities of the Spleen ; and hence the immense Quantity of Blood with which the Spleen is impregnated ; the like of which we do not see in any other Part. Here, then, the almost stagnant Blood, fermented with Heat, attenuated, and, in a Manner, dissolved by the putrid Fæces of the adjacent Colon, enters thus upon the first Steps of

a begun Putrefaction, as we learn by Experiments, both from its Colour and Consistence. But the greater Fluidity of the Blood herein, proceeds not only from this Dissolution, but because all its aqueous Particles, which enter by the Artery, return also again by the Vein; for there are no secretory Ducts in the Spleen.

Besides, when the Stomach is full of Food or Flatus, the Spleen is thereby compressed into a narrower Compass against the Ribs, and superincumbent Diaphragm; by which means the Blood, that before was scarce able to creep along through the splenic Veins, being now pressed out more plentifully, returns with a greater Celerity towards the Liver, till, mixing with the sluggish Blood in the Trunk of the Porta, replenished with the Fat, or Oil of the Omentum and Mesentery, it dilutes or thins the same, and renders it less apt to stagnate or congeal; and, at the same Time, it conduces to form a larger Secretion of Bile, at a Time when it is most wanted; viz. to flow plentifully to the Food now under Digestion. The Spleen, therefore, seems to prepare the Blood, that it may supply a sort of aqueous Fluid to the Bile; but such as is probably of a subalcaline Nature, and rendered somewhat sharp, or lixivial, by the Sejour of the Blood.

Hence we may be able to solve the Question, Whether the Spleen be like the Lungs of a spongy or cellular Fabric? and whether the Blood is poured out into those Cells, so as to stagnate in its Way to the Veins? or whether it be there diluted with some Juice secreted by peculiar Glands? We see nothing of this is demonstrable by Anatomy; nor does the Liquor or Wax injected ever extravasate into the cellular Substance, unless urged with much greater Violence than Nature ever uses, or intended. If it be asked, Whether Diseases do
not

not sometimes demonstrate a sort of glandular Fabric in this Part; and comparative Anatomy the same? As to the old Question, Whether the Spleen prepares an Acid to stimulate the Stomach? that Opinion has been long rejected, as repugnant to the Nature of all the animal Juices.

If it be asked, Whether the Spleen be not an useless Mass, as it might seem to be, from the little Damage an Animal sustains, after it has been cut out? We answer, That a robust Animal, suffering but little Injury from the Loss of a Part, does not prove it to be useless: On the contrary, we find, after such an Experiment has been made, that the Liver becomes swelled and disordered, makes a less Quantity of Bile, and of a darker brown Colour, whilst the Animal is perpetually troubled with Flatulencies, Gripes, or Indigestion; all which are to be ascribed to the vitiated Nature of the Bile, Obstruction of the Liver, and an imperfect or weak Digestion. HALLER's Prim. Lin.

OBSERVATIONS.

We read, in Cent. I. Observ. LIX. of STEPH. BLANCHARD, that he found in a Subject the Spleen weighed eight Pounds; the interior Substance full of black Matter like Pitch. Also, in Cent. II. Observ. XII. he likewise met with a Spleen of an immense Magnitude, and hard; the inferior Part whereof, towards the Ileum, was round, and full of black Blood. The Artery and Vein were about Half an Inch in Diameter.

HILDANUS relates, that he has seen the Spleen so tumified and large, as to reach the internal Surface of the Os Pubis.

Sometimes it is divided into several Portions, so as to be taken for distinct ones. In a Man of a good Habit, aged about Forty Years, the Spleen weighed

weighed Thirty-two Ounces; being nine Inches in Length, and five in Diameter; no way disordered, but in an intire perfect State: The other Viscera was not disproportionable to the Man, who was about five Feet six Inches in Height; an Account of which, with a Drawing, I gave to the ROYAL SOCIETY.

We read, in the *Histoire de ACAD. ROYAL DES SCIENCES*, in the Year 1700, that Dr. LITTRE, Anatomist to that ROYAL ACADEMY, presented to them the Spleen taken out of a Man aged Sixty Years, which was petrified; with the Membrane of another ossified. The Man was no way disordered in his Life-time.

As the real Use of the Spleen is not yet well known, it has occasioned a great many Hypotheses, not only by the antient Anatomists, who looked upon that Viscus as useles in the Body, which they have extracted from several Animals, and, in some Disorders of the human Spleen, they used to burn it, according to the Manner of their Practice; even some of the Moderns would persuade us, that the Spleen may be extirpated out of the human Body with Safety. I do not know that any Author has taken more Pains than Sir RICHARD BLACKMORE on that Viscus, in his Critical Dissertation, to endeavour to prove, from various antient Authors, that the Extirpation of it was practised in those Days, nay, even now, in Persia. But when we reflect on our modern anatomical Knowledge, I think no Man would be so rash as to attempt such an Operation. As for those Physicians who have accused this Viscus, as well as the other Viscera, of many Diseases, which very often, upon Dissection, prove groundless: I am apt to think, with C. AURELIANUS, that the human Spleen has oftener been amputated with the Tongue, than otherwise.



LECTURE X.

Remarks on the Description and Uses of the INTESTINUM DUODENUM.

Taken from Professor ALEXANDER MONRO'S
Medical Essays, Vol. IV. Art. 11.



THE Description and Draught of the Intestinum Duodenum, as given by most Anatomists, appearing faulty *, has occasioned this Paper, to rectify their Omissions or Mistakes.

From the Pylorus, which is raised upwards and backwards from the Stomach, the Duodenum descends obliquely to the right Side, with the anterior Lamella of the Omentum, fixed to its inferior Part, and the little Omentum, proceeding from the opposite Part, to connect it to the Liver: After this the Duodenum is involved, for about an Inch and a Half, in a Duplication of the Omentum, and then enters into the Duplication of the Mesocolon, where it cannot be seen without dissecting away that fat Membrane. It descends, in this cellular Sheath, till it is almost contiguous to the great Sac of the Colon, which properly is the human Cæcum. In this Descent the Colon lies before it; the biliary Duct, hepatic Ar-

* One would be apt to think that ingenious Professor had not read our learned and exact Anatomist Dr. WINSLOW, or else got the Description of the Duodenum given by him: However, the Reader may judge who deserves best.

tery and Nerve, Vena Porta, and emulgent Vessels, are behind it. The Liver, Gall-Bladder, and right Kidney, are on its right Side; and the Pancreas is on the left. This Intestine makes several Turns in this Progress; for it is raised into a Convexity forwards, where it passes before the Vessels of the Liver: Immediately after it bends backwards, and to the right Side, till it approaches the right Kidney, and then turns forward, and a little to the left, in its Course towards the great Sac of the Colon. The Duodenum then makes a considerable Curve to the left Side, where it is involved in a cellular Substance, which may be looked on as the common Root of the Mesentery and Mesocolon, through the Membrane of which it may be commonly seen. In the left concave Side of this Curve, the thick Extremity of the Pancreas Major and Pancreas Minor are lodged; the superior mesenteric Artery and Vein, coming through the Scissure between the larger and lesser Pancreas, hang loose before the Intestine here; and the Ductus Communis Choledochus, after passing behind the Intestine a little higher, unites commonly with the pancreatic Duct, a very little above the lowest Part of the Curve; and, after passing obliquely through the Tunics of the Intestine, the two Ducts open, by one common Orifice, in the posterior Part of the Duodenum. After the Curve just now described, the Duodenum is involved in the Root of the Mesentery, and ascends obliquely within it, towards the left Side, with the Vena Cava behind it; and, after a Course of about four Inches, rises forwards to acquire a proper Mesentery, or to commence the Jejunum, the Membranes of the Root of the Mesentery seeming to make a Ring, at which the Intestine comes out, though they are really continued

nued on the Intestine, and form its external membranous Tunic.

That all the Duodenum may be exposed to View, without changing its natural Situation, in a Body lying supine, it is necessary to cut through the great Arch of the Colon, below the Bottom of the Stomach, and, after turning the cut Extremity of the left Side over, on the left short Ribs, to take hold of the other Extremity of the Colon; and having separated it, with a Pair of Scissars, from the Stomach and Liver, taking away with it as much of the Omentum and Mesocolon as obstruct the View of the Duodenum and Pancreas, to lay it likewise on the right Loin.

When the Colon is removed, observe where the Roots of the Mesentery and Mesocolon prevent your seeing the Course of the Duodenum; at such Places cut these Membranes with a very sharp Scalper, directing the Incisions according to the Length of the Intestine, and then cautiously separate the Membranes to each Side, till all the Intestine is in View: Lastly, draw the small Intestines gently down, raise the Liver, and suspend the Fundus of the Stomach as much as is necessary to allow a full View of the whole Course of the Duodenum.

From this Description of the Duodenum, it appears, 1. That since it is involved in the cellular fat Substance of the Omentum, Mesocolon, and Mesentery, and is not braced into a firm Membrane, as the other Intestines are; it must more easily yield to any distending Force: And having the whole Substances thrown into the Stomach with the Bile and pancreatic Juice poured into it, it must receive more than any other Intestine; and then whatever enters it must go out with some Difficulty, because its Extremity, next the Jejunum, is fixed in a Course almost perpendicularly upwards,

upwards. Upon the Whole, it is no Wonder that this Intestine is frequently found so large as to be called *Ventriculus Succenturiatus*.

2. The ascending Course of the Extremity of this Intestine, and the Influx of the Bile and pancreatic Liquors into the most depending Part of it, where the Food makes the longest Stop, are wisely contrived both for the more easy Influx of these Liquors, and for a sufficient Quantity of them being mixed with the Food.

3. A pendulous Intestine here, would, in our erect Posture, have drawn the Stomach out of its due Situation, and might have twisted or over-stretched the biliary and pancreatic Ducts so as to have stopped the Course of the Liquors in them; and therefore it is firmly tied down in its whole Course.

The Duodenum of Brutes is likewise placed in such a Manner, as to answer the same useful Purposes.

Apes, whose Posture is, for the most Part, erect, or nearly so, have these Parts disposed in nearly the same Manner that Man has.

In Dogs, Cats, Cows, Sheep, and most other Quadrupeds, whose Posture is horizontal, the Pylorus and Beginning of the Duodenum, are firmly connected to the Liver; after which a considerable Piece of Gut, with a Mesentery, hangs pendulous, and then the Intestine is fastened to the Loins and Back-Bone: Therefore the pendulous Part must be lowest in them. The biliary Duct opens into the Duodenum, where it is tied to the Liver; the Pancreas is long, and lodged in the Mesentery along the pendulous Gut, and its Duct is near the Middle of that Gland.

Hens, Ducks, Geese, and other Fowls, whose Posture of Body is neither erect nor horizontal, but oblique, have the Beginning of the first small

Intestine well secured to the Liver, from which the Intestine runs near to the Podex, and returns again, to near the same Place where it began, to be again tied to the Liver, all between these two Connections being pendulous. The Pancreas is fixed between these pendulous Parts, and its Ducts open into that Part of the Intestine where it had returned back to the Liver, as the biliary Ducts also do, but with a Direction opposite to the Course of the Aliment in the Intestine; after the Entry of these Ducts, the Intestine runs a good way along the concave Part of the Liver towards the membranous Diaphragm, being fixed to the Liver and to the Air * Membrane which lines the Abdomen: At length the Intestine makes a Curve to the right Side, and takes its Course towards the Podex.

In Cod, Haddocks, and such Fish, the Cæcula, which are esteemed analogous to the Pancreas of other Animals, surround the first Intestine soon after it comes from the Stomach, and then the Intestine is fastened to the Liver, where the biliary Duct opens into it.

If then we consider what Quantities of different Substances enter the Duodenum, we need not be surprised that this Intestine should be more subject to Maladies than any of the rest; especially since it has not such a firm Covering as the other Intestines have: And if the Intestine itself suffers, how soon must it disturb many other Functions of the Animal Oeconomy, by the Pressure it may make, when over-stretched, upon so many large Vessels, Nerves, and other Organs, to which it is inseparably contiguous; or by communicating its Afflictions to those Parts which sympathize with it, by means of the common Origin of their Nerves,

* I do not know what Dr. MONRO means by the Air Membrane; whether he means the cellular or that of the Peritonæum.

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or by stopping the Influx of these two absolutely necessary Liquors the Bile and pancreatic Juice.

In Diseases of the epigastric or hypochondriac Regions, Care should be taken not to confound such as have their Seat in this Intestine with others, which require very different Treatment. This Caution is the more necessary, because Authors generally take little or no Notice of the Duodenum as the Seat or Cause of any particular Disease.

Other Remarks on the INTESTINES, &c. by the same Author. Ibid. Vol. IV. Art. 12.

The Intestines are said to be covered all over with a membranous Coat derived from the Peritonæum; but a considerable Part, a fourth at least, of the human Intestines, is not covered with such a Membrane. For the Mesentery being formed by the Peritonæum, produced on each Side, and including a considerable Quantity of cellular Substance, in which much Fat is frequently contained, together with the Glandulæ Vagæ, the meseraic Arteries and Veins, the Nerves, Lacteals, and fat cellular Substance, being thick, till after the Membrane of each Side is continued some way upon the Intestine, all the Space between the Membranes, has no such firm membranous Tunic covering it, and therefore more easily yields to any stretching Force, without over-stretching the Vessels.

In this Space between the Insertion of the Blood-Vessels, the longitudinal Fibres of the Intestines can be seen distinctly and easily, because the cellular Substance is separated with little Trouble, or collapses so much as not to hinder the View of the Fibres under it.

I need scarce observe that the circular Fibres of the Intestines are often so interlaced, that one can scarce trace the same muscular Fibre round the whole Intestine.

It is generally known, that all the Substance between the interior Side of the circular muscular Fibres of the Intestines and villous Coat, which used to be divided into the vascular, glandular, and nervous Tunics, can, by blowing into a Piece of Intestine, whose interior Side is turned exteriorly, be raised into a Tunica Cellularis, with numerous Vessels running every-where through it, without any Fat in it; where, however, it appears there is some Secretion performed: For by injecting Water into the Arteries, these Cells are filled with it; and frequently, after making Injections of grosser coloured Liquors, I see a Secretion performed, by the Cells being here and there distended with the white injected Substance, while the colouring Powder does not pass with it. When this secreted Liquor hardens, it forms a Number of small round or oblong Tubercles, which several imagine to be PEYER's Glands filled with the Injection; and this RUYSCH * seems likewise to think. I cannot yet bring myself to that Opinion, because Water diffuses itself so equally every where, and Injections which harden, do frequently the same for a large Space; at least these make it evident, that if PEYER's Glands are sometimes injected, there are also Vessels which convey Liquors into this internal cellular Membrane; which may lead us into a reasonable Account of the great Discharges of Mucus, after an Excoriation of the Guts, and of the hard Tubercles which are frequently seen within their muscular Membranes, and of several other Phænomena of Diseases.

* Epitel. 11. Respons. & Spasim.

In preparing a Piece of Intestine, in the Manner mentioned, for demonstrating its internal cellular Tunic, we have a good View of the Tunica Villosa in its membranous Form; when the Cellulæ are fully distended with Air, the villous Membrane loses the downy, papillous, and mammillary Appearance which it has when the Intestine lies floating in Water.

Upon observing this villous Membrane when it is stretched, and how thin and flexible the Cuticula becomes upon the Lips, with the Continuation of the same Membrane in the Mouth, Tongue, Fauces, Oesophagus, Stomach, and intestinal Canal; and, upon comparing the Properties which the external common Covering of the Body has with those of this villous Membrane, they seem to be much of the same Kind, if not the same continued Substance.

The Cuticula is pervious to Liquors going out of the Body, and to others coming into it; so is the villous Membrane of the Intestines; and both of them have other Passages through them, whereby they allow certain Substances to penetrate to the Nerves, which they cover.

Thus a Numbness is brought on the Skin, by immersing any Part of the Body in several Sorts of Liquors; and Pain is raised by Substances which do not destroy the Cuticle: Thus sapid Substances affect our Tongue; and the different Sensations arise which we frequently feel from the Contents of the Stomach and Intestines.

The external Epidermis, by being exposed to a Variety of different Forces acting on it, is of very different Thickness and Firmness, in several Parts; but it is naturally so flexible, as to allow a sufficient Impression of tangible Substances on the Nerves below it. The internal Membrane of the Intestines is less exposed to a Variety of such

Cauſes, and therefore is more uniform, but can be changed, in the ſame Manner, by like Cauſes.

And hence we frequently find the interior Surface of the Stomach and Inteſtines of a callous Hardneſs, and almoſt inſenſible; while, uſually, it is very ſenſible, and ſo flexible, that, being connected to the looſe cellular Subſtance, it hangs floating, and aſſumes any Shape the contractile Fibres of theſe Cells give it, whether of large Rugæ called Valves, or of ſmaller Papillæ of different Forms.

Thin watery ſaline Liquors waſh away the Cuticula, and thick mucilaginous Subſtances, protect it againſt them, and the bad Effects of Friction; therefore, wherever the Cuticula is expoſed to ſuch Injuries, its Defence is likewise provided.

Thus the Eye-lids are defended againſt the Tears; and their mutual Collifion, by the ſebaceous Matter, ſeparated in their Glands; the Nipples, Armpits, Glans, Urethra, Perinæum, &c. are all protected in the ſame Way.

When their Defence is wanting, Excoriation, Pain, Inflammation, &c. follow; the internal Membrane of the Inteſtines, being more expoſed to the Action of watery Liquors, has a more plentiful Supply of the protecting Liquors, and is, in a ſound State, lined with Mucus.

A moderate Degree of Friction makes little or no Change on the Cuticula; but a violent one, gradually applied, makes the Cuticle become thicker, ſtronger, and firmer; as we ſee in the Soles of the Feet, and in the Hands of labouring People. Experience ſhews, that ſudden violent Friction either rubs the Cuticula imperceptibly off, or ſeparates it from the Skin. The villous Membrane of the Inteſtines is not expoſed to ſuch Accidents as the Surface of the Body, and is better defended, by Slime, from the bad Effects of Attrition,

trition, while the Abrasion of this Membrane may well pass unobserved: But the thickening and hardening of the Cuticula by Friction, may, however, be seen in the Intestines, when any hard concremented Substance is lodged a considerable Time in them; for then the internal Surface becomes there thick and hard.

The Epidermis seems to serve for contracting the Extremities of the cutaneous Vessels, probably, by forming their Extremities: For whenever it is separated, these Vessels throw out their Liquors in much larger Quantities than ordinary.

If these Liquors were all thrown out of their Vessels, between the Skin and Cuticula, and thence gradually escaped through the Interstices of the cuticular Scales, there would perpetual Blisters be raised in the depending Parts of the Body, if not all over the Surface of it; and the Liquor in Blisters would escape through these Interstices. The same Effusion of Liquors is made into the Intestines, on the Separation of the villous Coat, in Diseases where the Tongue and Throat shew the excoriated State of the alimentary Canal.

When any Part of the Cuticula is separated from the Skin, but still is continued with the adherent Scarf-skin, it becomes thicker, especially if soaked with Liquors.

Thus the Cuticle of Blisters, and what separates from the Edges of Wounds and Ulcers, is frequently very thick: The same Thing happens in the alimentary Tube, as is evident in Aphthæ.

This Observation accounts for the tubular thick Substances voided at the Anus, which have been taken for Pieces of the Intestines.

The Epidermis is the most incorruptible, and least subject to Erosion, of any Part of the Body.

In Abscesses, the Pus has little other Effect on it than to separate it from the Skin, and to tear it

by its Weight, but not to dissolve it. In Gangrenes and Sphaceli it remains uncorrupted; after all that it covers is converted into a putrid Mash; nay, it can allow the common Lapis Sapticus to penetrate through it, and dissolve the Parts below, without suffering a Solution of its own Substance. This may be owing to its having no proper Vessels or Liquors. The Tunica Villosa enjoys the same Advantages in both.

These Membranes, though indissolvable, are, however, separable from the Parts they cover; the Consequences of which are bad; therefore they are the most easily and quickly regenerated of any Organs in the Body which are not of the same Structure.

I never saw the Appendix Vermiformis, of any of the human Fœtules which I have dissected, distended with Meconium; and therefore cannot allow it to serve as a Reservoir of the Fæces during Gestation.

From the numerous mucous Lacunæ in the human Appendix, and the like Structure in the Cæca of Brutes, its Use appears to be, to furnish Mucus, to lubricate the internal Surface of the great Sac of the Colon, and to moisten the Fæces in it, that they may be more easily pushed forward out of this Part of the Intestine, where there is the greatest Difficulty in their Progress, and where, by stagnating too long, they may bring on troublesome Symptoms: Witness the Disease called Placenta Intestinalis.

The proportional lesser Size of this little Intestine, in an Adult more than in a Fœtus, depends on the Pressure it suffers, and being emptied so frequently of its Contents; whereas, in a Fœtus, there is no Respiration to squeeze it; and the Meconium in the Sac of the Colon prevents its being emptied: So that the Liquor separated by
its

its Glands being collected there, relaxes its Fibres, and distends it.

The Neglect of considering what the different Forces are which act upon the several Organs of the Body, while in a Fœtus State, and after Birth, has, in my Opinion, contributed to many Disputes, which might have been put an End to by accounting for the Phænomena which were the Subject of them in this Way of Reasoning. I shall mention one remarkable Difference in the Circulation of the Blood, and some few Consequences from it.

Though the Heart and Arteries of Animals are able, by their Action, to keep up a Circulation in the larger Vessels; yet, without Assistance from some other Powers, they cannot propel the Liquors with Velocity, and in sufficient Quantity, through the small Vessels. These assisting Powers, after Birth, are the alternate Pressure of Respiration, and the Action of the Muscles. We can observe, at any Time, how much the Circulation is quickened by increasing these; and, on the contrary, how much all the secreting Organs are distended and stretched by their almost stagnating Fluids, whenever one of them (to wit, muscular Motion) is little exercised.

Thus Creatures turn fat, when they have no Exercise. Hence a Recruit of all the necessary Liquors in Time of Sleep; hence the strong slow Pulse of sleeping People; hence the Desire of continuing Sleep after a Person has slept beyond his ordinary Time; hence the small Waste of such Creatures as continue long in a dormant Condition without any Supply of Food; hence a dry parched Mouth in the Morning, which is soon relieved by Chewing; hence Stiffness and Laziness after abstaining from Exercise too long; and a great many other Phænomena which will occur to any one, upon the least Reflection.

Since

Since, then, the Heart and Arteries of Fœtuses have little or no Assistance from any alternate Pressure in propelling their Liquors, their discerning Organs must also be stuffed up, and distended; and therefore of a larger proportional Size than in the Adult. It is commonly said, that the Thy-mus and Glandulæ Renales lose more of their proportional Size in the Adult, than the other Organs. Admitting this as a Fact, though, on comparing them with the Brain, and some others, it is doubtful, it will not bring us under any Necessity of searching out some particular Use to which they serve in the Fœtus: For a View of their Circumstances, as to Situation and Pressure, will account for all the Differences observable in them. To understand this rightly, it may not be amiss previously to consider one or two Causes which may influence the Growth of animal Organs.

1. The Growth of the Parts of the Body will be greatest where they are least confined, and least exposed to pressing Forces. The Brain is at first inclosed in Membranes, and is prodigiously large, in Proportion to the other Members; as the Bones of the Cranium become firm, its proportional Size diminishes; and after they are fully joined, its proportional Increase is very little: The Testicles, on the contrary, are at first confined within the Abdomen, and small; and afterwards, when they fall down into the Scrotum, they increase much faster.

2. The greater the Force is, with which the Fluids are thrown into Parts, or the greater the Resistance is to the Liquors, the more the Bulk of the Part will be increased. A Hand swells upon pressing the Veins of the Arm; a Tumor in the Urethra, near the Caput Gallinaginis, occasions a Swelling of the Testicles.

To apply these Principles to the Thymus and Glandulæ Renales, we need only call to our Remembrance the Situation of one, in the double Mediaſtinum, between the Heart and its large Veſſels; and the Sternum, with the Lungs on each Side: The other lies on the muscular Appendix of the Diaphragm, covered before by the chylopoietic Organs. Neither of them have any excretory Canal, except the lymphatic Veſſels are eſteemed ſuch; the Veins of both have a ſhort Courſe; and that of the Glandulæ Renales is remarkably large.

The greater Preſſure which the Thymus ſuffers after Birth, from the increaſed Action of the Heart and Lungs, is altogether evident; the immediate Play of the Diaphragm upon the other, ſhews as evidently, that there are ſcarce any glandular Parts in the Body; the Change upon which, as to Preſſure, is greater, after Birth, to what it was before, than in theſe two: And therefore, by our firſt Propoſition, they ſhould ſuffer in their Growth upon this Account.

But to this is to be added the Thinneſs of the Fluids ſent from them, and their ſhort Courſe in large Veſſels, which are almoſt peculiar to them; by which thin Veſſels muſt be leſs diſtended, and, conſequently, their Increaſe leſs, by the ſecond Propoſition.

Theſe Organs perform the Office of lymphatic Glands, both before and after Birth, and dilute the Chyle and thick Blood, which is ſoon after to be returned to the Heart.

☞ It is hoped, that the nice medical Reader will indulge our ingenious Author as to the Oddity of his Expreſſions; which, perhaps, are not ſo anatomical as one might expect from a Man of ſo great Repute.



LECTURE XI.

Of the KIDNEYS.

THE Renes, or Kidneys, are two pretty solid glandular Bodies, situated in the posterior Part of the Cavity of the Abdomen, on each Side of the lumbar Vertebrae, between the last false Ribs and *Ossa Ilium*. The right Kidney lies under the great Lobe of the Liver, and is, consequently, lower than the left, which lies under the Spleen.

The Figure of the Kidneys resembles that of a large Kidney Bean; their Circumference being convex on one Side, and concave on the other. The concave Side is turned to the Vertebrae, and the convex Side the opposite Way. Their Length answers to the Distance between the last false Rib and *Os Ilium*: They are about half as broad as long, and half as thick as broad.

In each Kidney we observe an anterior and posterior Side; a superior and inferior Extremity; a great and small Curvature, and a Convexity and Concavity.

The posterior is broader than the anterior Side, and the superior Extremity is a little broader, and more incurvated, than the inferior. The Depression in the small Curvature is oblong and uneven, resembling a Sinus, surrounded by several Tubercles; and as it is turned a little towards the anterior,

rior, this Side is somewhat narrower than the other.

The Kidneys are surrounded by a very loose membranous and cellular Covering called *Membrana Adiposa*, because in fat Persons the Cells of this Substance are filled with Fat. This was, for a long Time, taken for a Duplicature of the *Peritonæum*, the true membranous Lamina of which covers only the anterior Side of the Kidneys; and, consequently, they lie without the *Peritonæum*, because the Portion of that Membrane that covers them cannot be looked upon as an intire Tunic; so that the only common Tunic they have is the cellular Substance which likewise invests the renal Arteries and Veins in Form of a Vagina.

The proper Tunic or Membrane of the Kidneys is composed of two Laminæ, between which there is likewise a very fine cellular Substance, which may be made sensible by blowing through a Pipe between the two Laminæ.

The external Lamina is very thin, and adheres closely to the internal Lamina by means of the cellular Substance; the internal Lamina penetrates every where, by numerous Elongations, into the Substance of the Kidney, from which it cannot be separated without tearing.

The Surface of the external Lamina is very smooth, polished, and glistening; and it renders the whole Surface of the Kidney very even and uniform in Adults: In Children this convex Surface is, in a manner, divided into several Lobes or Tubercles, almost as in Oxen and Calves; and in grown Persons we sometimes observe the same Inequalities.

SANGUIFEROUS VESSELS OF THE KIDNEYS.

The descending Aorta and inferior Vena Cava lie between the Kidneys, pretty close to the Bodies
of

of the Vertebrae, and to each other; the Artery being on the left Hand, the Vein on the right. Each of these large Vessels sends out transversely, towards each Side, commonly one capital Branch, which goes to the Kidney, and enters the Sinus, or Depression thereof, by several Rami.

These Vessels were by the Antients termed the emulgent Arteries and Veins; but I think the Name of *Arteriæ Venæ Renales* is much more proper. Sometimes there are more than one of each Kind, which is oftenest found in the Arteries, sometimes on one Side only, and sometimes in both.

The Artery and Vein are not of an equal Length; and the Difference depends on the Situation of the Aorta and Vena Cava: For the left renal Artery is shorter than the right, because the Aorta lies nearest the left Kidney; and the left renal Vein is longer than the right, because the Vena Cava lies farthest from the left Kidney.

These Vessels are likewise disposed in such a Manner, that the Veins lie more anteriorly than the Arteries, because the Aorta lies close to the Spina Dorſi; whereas the Vena Cava, which perforates the Diaphragm at some Distance from the Vertebrae, does not join them till after it has given Rami to the renal Veins.

Each renal Artery is surrounded by a nervous reticular Texture, called *Plexus Renalis*, which furnishes a great Number of Filaments to the Kidneys, which come partly from the femilunar Ganglions of the two great sympathetic Nerves, and partly from the *Plexus Hepaticus* and *Splenicus*. This renal *Plexus* sends likewise some Filaments round the renal Veins.

The sanguiferous Vessels, having entered the Kidneys, are ramified every Way; and these Ramifications send out other capillary Rami, which go all the Way to the Surface, where they appear like irregular

gular Stars, and furnish the proper Membrane of the Kidneys. Sometimes these two Ramifications penetrate to the *Membrana Adiposa*, and communicate there with the *Arteriæ* and *Venæ Adiposæ*.

The proper Membrane, having surrounded the Kidney all the Way to the Sinus, joins the Vessels at that Place, and accompanies all their Ramifications, thro' its Substance, in Form of a Vagina or Capsula; and likewise contributes, partly, to the Formation of the Pelvis and Infundibula.

We sometimes observe a considerable Vessel to ingress or exit from the convex Surface of the Kidney, but this is not common; and in that Case there is a Depression by which the proper Membrane enters, and communicates with that Portion which goes in by the Sinus.

The *Tunica Adiposa*, or common Membrane, which likewise invests the great Vessels to their Entry into the Kidneys, does not seem to accompany them any farther; but terminates at the Sinus, in the Interstices between the Ramifications.

STRUCTURE OF THE KIDNEYS.

We may distinguish three Kinds of Substances in the Kidneys: An exterior Substance, which is thick, granulated, and in a manner cortical; a middle Substance, which is medullary and radiated, called *Striata*, *Sulcata*, or *Tubularis*, because it seems to be formed of radiated Tubes; and an interior Substance, which is only a Continuation of the second, and terminates on the Inside by *Papillæ*; for which Reason I chuse to name it *Papillaris*.

These three Substances may be seen distinctly in a Kidney, by cutting it into two equal Parts thro' the great Curvature. The cortical Substance may be observed round the whole Circumference; and by the Microscope we perceive it to be of a spongy,
gra-

granulated, and waving Texture; all its Parts adhering together in a radiated Manner. Its Colour is a bright whitish Grey*.

The other two Substances, that is, the medullary or striated, and papillary, are really but one and the same Mass, of a more reddish Colour, the convex Side of which rises, at several Places, into narrow Tubercles, lodged in the same Number of Cavities or Depressions: The radiated Striæ are afterwards continued to the papillary Portion; and the Papillæ form, in some measure, so many Centers of these Radii, or Rays, opposite to the Tubercles.

The medullary Substance is likewise distinguished from the cortical by the arterial and venal Curvatures, which send capillary Ramifications on all Sides; and its Colour is more or less red.

The Papillæ, which are only a Continuation of the medullary Substance, as has been said, are often a little paler than that Substance. They are ten or twelve in Number, very distinct from each other, resembling the same Number of Cones, with very broad Bases, and obtuse Apices†.

At the Point of each Papilla we see, even with the naked Eye, in a small Depression, several very small Apertures, through which little Drops may be perceived to run, when the Papillæ are compressed: These are little Drops of Urine, which being filtered, partly in the cortical, and partly in the medullary or tubular Substance, do afterwards

* By fine anatomical Injections, or in Inflammations, we discover an Infinity of small capillary Vessels, which run, in various Directions, between and round the different Portions of this Substance; and, by the Help of a Microscope, we likewise see great Numbers of small red Corpuscles more or less round, and disposed almost like Bunches of Currants. These small Corpuscles are, perhaps, only the Extremities of the cut Vessels, filled either with Blood, or a coloured Injection.

† These are also named *Tubuli Urinarii* Beilini, from the Author who first described them; but their Number varies greatly in human Subjects.

pass through the Substance of the Papillæ, and are discharged by these Orifices.

Each Papilla lies in a kind of membranous Calix or Infundibulum, which opens into a common Cavity called the Pelvis: This Pelvis is membranous, being of the same Structure with the Calices, of which it is a Continuation; and its Cavity in Man is not uniform, but distinguished into three Portions, each of which contains a certain Number of Infundibula or Calices, together with the Papillæ which lie therein; and sometimes we find two or three Papillæ in the same Infundibulum.

At the Place where these Infundibula surround the Bases of the Papillæ, they send Productions into the medullary or radiated Substance of the Kidney, which accompany the Blood-Vessels, and serve for Capsulæ or Vaginæ to all the vascular Curvatures, both arterial and venal, and to their different Ramifications, quite through the cortical Substance, and as far as the Surface of the Kidney.

After the Infundibula have contracted into a conical Form round the Apices of the Papillæ, each of them forms a small short Tube, which uniting at different Distances, along the Bottom of the Sinus of the Kidney, form three large Tubes which egress from the Sinus, in an oblique Direction, from above downwards, and immediately afterwards unite into one Trunk.

This Trunk becomes a very long Canal, called the Ureter. In Men, the three Tubes supply the Place of what is called the Pelvis in Brutes, and might more properly be called the Roots or Branches of the Ureters, than the Pelvis; which Name would agree best to the Trunk, as being larger than the rest of the Ureter. The Ureters are commonly two in Number, one for each Kidney; but sometimes there are more than two.

The Situation of the Trunk, and of the Roots and Branches of each Ureter, with respect to the renal Artery and Vein, is in the following Manner: The Artery is in the superior Part of the Sinus, and partly before the Vein; the Vein is about the Middle, and between the Artery and Ureter; the Ureter is in the inferior Part, a little behind the Vein; and it is partly surrounded by one Branch of the Artery.

This Disposition appears plainer near the anterior than near the posterior Side of the Kidney, because this last is broader than the former; and we likewise see there the three Branches of the Ureter, of which the superior is the longest, and the inferior the shortest, because of their oblique Direction inferiorly.

From this Description we see, that, in the human Kidney, there is no other common or uniform Pelvis but the Trunk or Head of the Ureter, and the three great Branches. To have a true Idea of their Disposition, we must imagine, that the Ureter enters the Kidney by the inferior Part of the oblong Sinus; that it increases gradually in Breadth as it advances, and is divided into three Branches, before it enters the Substance of the Kidney.

One of these Branches may be considered as a direct Continuation of the Ureter, and it is longer than the rest; being extended from the inferior to the superior Part of the Sinus; and it may be found without much Preparation: The other two Branches are shorter, and cannot be well discovered without an artificial Separation. The Angles between these Branches at their Bases, or at the Head of the Ureter, are not pointed as those of other Ramifications, but formed by a round Incurvation, which is generally surrounded by Fat.

These first Branches of the Ureters produce other small Branches at the Bottom of the Sinus, which

which are disposed in Pairs; these small collateral Branches extend in Breadth, and form the Infundibula or Calices, in which the Papillæ are lodged; the great Circumference of which produces, in the Substance of the Kidney, the different Vaginæ of the vascular Curvatures, and of their Ramifications. The internal Lamina of the Kidney is continued round these Vaginæ, and the external is expanded round the first Branches, Trunk, and all the rest of the Ureter.

If the Trunk of the Ureter be split on that Side which is next the Vertebrae, and this Section be continued to the Extremity of the superior Branch, we may observe, immediately above the Trunk, two Foramina lying near each other, which are the Orifices of the small collateral Branches, and Tubuli of the Infundibula: A little above these Foramina there are two others very much like them, and so on all the way to the Extremity of the superior Branch, which terminates likewise by these Tubuli of the Infundibula; and in each of these Tubuli we may observe, at least, the Apex of one Papilla*.

The Ureters run down obliquely, and with a very small Degree of Inflexion, from the Kidneys to the lateral Parts of the inner or anterior Side of the Os Sacrum, and, passing between the Rectum and Bladder, they terminate in the last of these Viscera in the Manner that shall be explained hereafter.

They are composed of three proper Tunics: The first of which, that surrounds the rest, is of a whitish Colour, and of a very compact filamentary

* A Section begun on the convex Surface of the Kidney, and carried from thence to the Trunk of the Ureter, discovers the Extent of the Papillæ very plainly, and likewise the Infundibula, their Tubuli, &c. but it will be difficult to give Beginners a just Idea of the Structure of these Parts, without the other Section.

Texture, being stretched with Difficulty, and appearing like a filamentary Substance degenerated; the next Tunic is of a reddish Colour, stronger than the first, and formed of different Strata of Fibres, which intersect each other; the interior Tunic is in some measure ligamentary, and lined with a very thin Membrane which covers a very delicate reticular Texture of Vessels: It is slightly granulated like shorn Velvet, and moistened all over by a mucilaginous Liquor; it has several longitudinal Rugæ, which are intersected by a great Number of small transverse ones.

Besides these proper Tunics, the Ureters are invested by the cellular Substance of the Peritonæum, the membranous Lamina of which covers likewise about two Thirds of their Circumference, sometimes more, sometimes less, but never surrounds them intirely; so that, when they are examined in their natural Situation, they appear like Ropes lying behind the Peritonæum, and jutting out, more or less, towards the Cavity of the Abdomen, together with that Portion of the Peritonæum which covers them.

All that has been said about the Structure of the Ureters, Pelvis, Curvatures, Striæ, Fossulæ, and Apertures at the Apex of the Papillæ, appears most distinctly, when these Parts are examined in clear Water.

VARIOUS CONJECTURES ON THE SECRETION OF THE URINE.

The Kidneys are the Emunctories of the Body: There is no other Part that seems to receive the Urine. If we tie the emulgent Arteries, nothing is collected, either in the Ureters or Bladder. Some Anatomists, nevertheless, are of Opinion, that there are other Ways. The Ligature of the
emulgent

emulgent Arteries does not seem to them to be a convincing Proof: Because then the Convulsions and Disorders which arise, shut the Strainers which are open when all is calm. These are the Reasons which make them doubt whether there are no other Canals discharged into the Bladder.

1. Mineral Waters pass into the Bladder almost at the very Instant they are drank: The same Thing would happen to those who drink much Wine. 2. The Water of dropical People, contained in the Abdomen, is emptied, by Urine, in the same Manner as Abscesses of the Breast. 3. Clysters are sometimes voided thro' the Bladder, soon after they have been taken in.

These Reasons do not prove a Duct different from that of the Kidneys. 1. Mineral Waters, the same as Wine, do not immediately issue out from the Ureters; it requires some Time: Because they must pass through the lacteal Vessels, thoracic Duct, subclavian Vein, Vena Cava, right Ventricle of the Heart, the Lungs, left Ventricle, Aorta, and the Emulgents. But when all that Space contains Mineral Waters, or Wine; then we may observe, that we cannot continue drinking without continually making Water; since, in Proportion as the Wine or Waters advance, a proportional Quantity of Urine is discharged.

2. The Water of dropical People may re-enter the Veins by the absorbent Tubes. Does not the Water, when we bathe, enter our Bodies? Are there not Abscesses in the Extremities, which are suddenly propelled? For this could not happen, if there were no absorbent Tubes inserted in the Veins: The Arteries could not receive them. For the Heart, which there continually propels the Blood, opposes the Entry of the Fluids.

It has been asserted, that the exterior Side permitted the Water to enter into the Cavity, and that the interior did not permit it to issue out. For this Reason, there have been Vessels, covered over with Bladder, and the external Surface was placed externally. The Water, say they, which, when poured upon that Vessel, penetrates the same, does not happen when the Membrane is applied to the Vessel in such a Manner that the external Surface answered to the Cavity. But this Experiment has not been successful to all those who have tried it. Besides, Waters spread in the Abdomen are not emptied that Way: On the contrary, dropical People make but very little Water.

3. Clysters can enter the lacteal Vessels which have been found in the Colon: They can even pass into the small Intestines, provided the Cæcum be not inflated; for the Entrance is not closely shut up but when the Cæcum is extended. After Clysters have passed through the Lacteals, they will be carried to the Kidneys in the common Way: It may even happen, that they will not receive any great Change. We see that the Chyle has not been intirely changed in five Hours after a Meal.

Notwithstanding all these Reasons, there may be some private Passage which leads to the Bladder.

The ingenious WINSLOW has discovered a Saccus that reaches along the Spine, and terminates under the Stomach. Could not this Sac serve to carry the Urine through some Passage? Having seen that the Kidneys are the only Places where the Urine is secreted; let us see how it is filtrated.

The Blood propelled in the emulgent Arteries dilates the Ramifications which are spread all over the Substance of the Kidneys: These Ramifications, dilated, compress the Blood which is contained in them, and propels it towards the Tube which they send to the Papillæ; but as these Canals

nals are narrower than the Extremities of the sanguinary Arteries, they will not be able to receive the red Part, nor the thick Lymph: But, 1. The aqueous Part will enter: For if we inject the emulgent Arteries with warm Water, the Water passes into the Veins, Lymphatics, and Ureters. MALPIGHI had no Success in this Experiment: But the Reason is, because he did not try it in a fresh Subject. The Air passes in the same Manner in these Tubes, as NUCK has asserted.

2. The oleaginous Particles attenuated, will make their Exit through these Tubes, and, consequently, will become a Fluid of a yellow Colour: For the Heat, which attenuated the Oil, gives it, at the same Time, a yellowish Tincture.

3. As the secretory Tubes of the Kidneys are larger than those of the other Strainers, the terrestrial and saline Particles can pass there: It is also this which we see by the Sediment found at the Bottom of Urinals. By this it appears, if, to explain the Secretion of the Urine, we must have Recourse to Ferments, Precipitations, or the Opinions of an infinite Number of Authors, who have abandoned an easy Mechanism for Ideas which have no Experiment to confirm them.

The Blood is continually propelled, in great Quantities, to the Kidneys, before they are freed of those aqueous and oleaginous Particles in the secretory Ducts: It is necessary, therefore, that the Urine be, in great Plenty, secreted in the Kidneys. The Blood, which flows to the inferior Parts, is deprived of its aqueous Part, and of a subtil Oil; that which enters the cutaneous Arteries, leaves, in the secretory Ducts of the Skin, the Matter of the Sweat and Transpiration. It follows hence, that, after reiterated Circulations, there is less Water carried towards the Kidneys; and thus the oleaginous Particles, which will be there deposited, will

be less diluted, and grow yellower than the preceding; since its Parts will not be mixed with Water, which clears its Colour, and makes it fluid. Besides, the Heat this Oil has acquired, through so many Circulations, will again give it a deeper yellow, and render the Salts more acrimonious. It is for this Reason, that, when we have fasted a long Time, the Urine becomes very yellow and acrimonious.

If the Blood was propelled impetuously into the renal Ducts by the Power of the Heart, or Arteries, it would force the Ducts, which before received nothing but an aqueous and oleaginous Matter attenuated, and, consequently, we should piss Blood; and this happens in the Small Pox, to those who have a Stone in the Kidney, and those who have the renal Ducts very open, or lax: But if it should happen that the Arteries were very much inflated by the Blood, then would ensue a Suppression of Urine; for the inflated Arteries would compress the secretory Ducts, and so, consequently, would obstruct the Passage for the Fluid there filtrated. In order to make Urine, there is a Necessity for a considerable Contraction of the Arteries: For whilst they contract, the Veins and excretory Ducts can be filled; which is the Reason why Opium stops the Urine: But if the Blood, in swelling the Arteries, hinders the Secretion of the Urine, the Tubes can there produce another Hindrance, by contracting. Hence it is, that, in hysteric Fits, the Urine is like Water; the Convulsions which contract the Nerves, contract likewise the urinary Strainers. The same Thing happens in inflammatory Diseases, and Suppressions which arise from the Obstruction of the Kidneys. These Symptoms will go off by relaxing or diluting Medicines, or Bathing; which always augment the Secretion of the Urine.

If

If it happens that Blood flows in the Kidneys which is too thick, or that many terrestrial Particles are pressed against each other in the Mamillæ, or Papillæ; it appears, that Concretions may be formed in the Tubes which filtrate the Urine; it is sufficient that there is a Matter stopped there, that the oily Substance may stick there by Strata. For supposing grumous Blood or terrestrial Particles in the Mamillæ; the Oil, which is viscous, would obstruct those Concretions; the ensuing Heat would cause the Fluid to evaporate; or the Pulsation of the Arteries, and Pressure of the Muscles of the Abdomen, would press it out. Thus the dried Matter would form a Mass of those Bodies it met with.

This is what happens in the Filtration of the Urine. In short, when it is distilled, by Drops, from the Mamillæ, by the Pressure of the Heart, Arteries, Elasticity of the Fibres, Muscles of the Abdomen, and Respiration; it is received by Calices, which are Branches of the Extremities of the Ureters; and, either by its Weight, or the Urine which follows, or, lastly, by the Pressures before mentioned; it runs into the Ureters*.

The Blood of the renal Artery being less fluid than that of the Brain, and, probably, stored with more Water, brought by the serpentine Circles of the Arteries, deposits the aqueous Portions into those rectilineal Tubes of the Papillæ; a great Part of which Water contains Oil and Salts, intermixed with terrestrial Particles, or such Bodies as are small enough to pass through with it. But the small Diameter of each Uriniferous Duct itself, at its Origin, and its firm Resistance, seem to exclude the Milk or Chyle, and the thick or oleaginous and lymphatic Particles of the Blood, which are capable of hardening by Heat. Hence, therefore, it

* See Physical Essays on the Animal Oeconomy.

is, that the Blood passës so easily through the open Uriniferous Tubes, whenever it is urged with an increased Celerity; or that by a morbid Relaxation they transmit not only oleaginous Particles of the Blood, but even Milk and nutritious Substances themselves. The Urine, by Fire, or Putrefaction, soon changes into a volatile alkaline Nature, intermixed with a foetid Oil, partly empyreumatic, yellow, and volatile; and partly very tenacious; to be separated only by the last Degrees of Fire, under the Denomination of Phosphorus: And, lastly, it abounds more with Earth than any other Fluid of the Animal.

But there is also a considerable Portion of Sea Salt residing in fresh Urine, from which it is even separable, after a long Putrefaction, in the making of Phosphorus; in which Process a very great Portion of the Urine is changed into a volatile Alkali. Nor is the Urine wholly destitute of volatile Acid, or at least one much akin to it, both in that of Man and Brutes: But there is also a Sort of fusible neutro-alescent Salt separable in the Urine, and easily dissolvable by Heat. In Fevers, the oleaginous and saline Particles of the Urine are greatly augmented, together with an Acrimony; as we know, by its increased Weight, Colour, and Tenacity. HALLER's Prim. Lin. Phys.

GLANDULÆ RENALES, or CAPSULÆ ATRABILIARIÆ.

Immediately above each Kidney lies a glandular Body, called, by the Antients, Capsulæ Atrabiliaris; by others, Capsulæ Renales, Renes Succenturiati, and Glandulæ Renales: And they might be properly enough termed Glandulæ Supra-Renales*. They are situated on the superior Ex-

* First described by EUSTACHIUS, in Lib. de Renibus.

trernity of each Kidney a little obliquely, that is, more towards the interior Margin and Sinus of the Kidney than towards the external convex Margin.

Each Gland is an oblong Body with three Sides, three Margins or Edges, and two Points, like an irregular Crescent with its great or convex Edge sharp, and the small concave Edge broad. Its Length is about two Thirds of the greatest Breadth of the Kidney, and the Breadth of its middle Portion is about one Third of its Extent between the two Extremities, sometimes more, sometimes less. Its Colour is a dark Yellow.

It has an anterior, a posterior, and an inferior Side, which last may be termed the Basis; and it has one superior and two inferior Edges, one of which is anterior, the other posterior. The superior Edge may be called *Crista*, and the two inferior Edges, *Labia*. One of its Extremities is internal, or turned towards the Sinus of the Kidney; the other is external, or turned towards the gibbous Part of the Kidney. The Figure of this glandular Body may likewise be compared to that of a single Cock's Comb.

Structure of the RENAL GLANDS.

The Surface of these Glands is uneven: The anterior Surface is the broadest, and the inferior Side, or Basis, the narrowest. Along the Middle of the anterior Side, a Ridge runs from the Edge of the interior Extremity, a little above the Basis, to the Point of the other Extremity, and divides this Side into two equal Parts, like the middle Rib of the Leaf of a Tree; and on the inferior Side, under the Basis, there is a kind of Raphe, or Suture.

The sanguiferous Vessels of these Glands come from the *Arteriæ*, *Venæ Renales*, *Diaphragmaticæ*, and likewise from the *Aorta*, *Vena Cava*,

Arteria Cæliaca, &c. These Vessels are termed the capsular Arteries and Veins; and, as they enter the Glands, they seem to be invested by a Vagina. They are not always derived from the same Sources, nor is their Number the same in all Subjects; and there is commonly a pretty large Vein, which runs along the Ridge. The Nerves, on each Side, are furnished by the adjacent semilunar Ganglion, and the renal Plexus which depends on it.

In the Inside of these Capsulæ there is a narrow triangular Cavity, the Surface of which is full of short strong Villi, of a yellowish Colour; but in Children it is reddish, and of a dark brown in aged People. The Sides of this Cavity are connected by a great Number of Filaments; and they appear to be wholly glandular, that is, to be filled with very fine small folliculous Corpuscles. Along the Top of the Gland these Sides touch each other immediately.

On opening this Cavity, we find a granulated or follicular Substance, which almost intirely fills it; and the sanguiferous Vessels are distributed on this, as well as on the Sides of the Cavity. If the Section be begun at the great Extremity of the Capsula, and continued through the superior Margin; and if the lateral Portions be afterwards separated, the glandular Body appears like a kind of Crista, raised from the Middle of the Bottom of the Cavity.

This glandular Body, or Nucleus, adheres more closely to the Bottom or Basis of the Cavity, than to the two Sides, especially near the great Extremity; but yet it may be separated, both from the Basis and Sides, being connected to them by a great Number of small Filaments. It adheres least to the Basis, near the small Extremity.

The capsular Vein, which usually comes from the Vena Renalis, is much larger than the Arteries; and it communicates with the Inside of the Capsula much in the same Manner as the Vena Splenica with the Cells of the Spleen: For it may be inflated by blowing into any Part of the capsular Cavity; and the Air likewise passes into the Vena Renalis, &c.

This Cavity contains an unctuous viscid Liquor of a yellowish red Colour, which with Age changes gradually into a yellowish Purple, a dark, or a black Yellow; and sometimes it is perfectly black: But, even then, if it be spread thin on a large Surface, it appears yellow. It has sometimes been found not only reddish, but mixed with real Blood.

The Uses of these renal Glands have not, as yet, been discovered: And all that we know about the Liquor contained in them is, that it resembles the Bile. They are very large in a Fœtus, and diminish in Adults. These two Phænomena deserve our Attention to inquire about them.

They lie sometimes directly on the Top of the Kidneys; but I never found them on the gibbous Part. The Gland on the right Side is partly connected to the Diaphragm under and very near the Adhesion of the great Lobe of the Liver to that Muscle; that on the left Side adheres to the Diaphragm below the Spleen; and both these Connections are confined to the contiguous Portions of the inferior Muscle of the Diaphragm. They are involved, together with the Kidneys, in the Membrana Adiposa, a very thin Portion of which insinuates itself between the Kidneys and Glands, and also between them and the Diaphragm; so that they adhere to both by the Intervention of the cellular Substance, which in some Subjects contains a Stratum of Fat.

The venal Ridge, already mentioned, sinks so deep into the anterior Side, in some Subjects, that the superior Part of this Side appears to be separated from the inferior: But this is seen most distinctly when the Capsula is examined in clear Water.

When the capsular Vein is opened lengthways with the Point of a Lancet, we discover in it a great many small Apertures, many of which are only the Orifices of the Rami of the Vein; others are simple Apertures; and it is, perhaps, through these that the Air passes into the Gland, as already mentioned.

On the external Surface of these Capsulæ we observe a very thin distinct Membrane, separate from the cellular Substance which surrounds them. Sometimes this Membrane is raised by an uneven Stratum of Fat, which makes it appear granulated; and, for the same Reason, the Capsulæ are of a pale Colour, like a Corpus Adiposum.

The Liquor contained in them appears sometimes in a Fœtus, and young Children, of a bluish Colour inclined to red.

To be able to discover the Uses of these Capsulæ, we must not only attend to the two Circumstances already mentioned, but also to their external Conformation, which is commonly more regular in a Fœtus and Children, than in Adults and old People. We must likewise consider the Consistence and Solidity of their Substance, which is greater before Birth, and in Childhood, than in an advanced or old Age; in which they are often very flaccid, and very much decayed: And this perhaps may be the Reason why the Figures given of these Glands taken out of their Membrana Adiposa, are so very irregular.

VARIOUS CONJECTURES CONCERNING THE
USES OF THE CAPSULÆ ATRABILARIÆ,
OR RENAL GLANDS.

The Uses of the Capsulæ Atrabilariæ are, as yet, unknown: Their Structure affords us no Knowledge of them. MALPIGHI asserts, that if we cut them lengthways, they appear to be composed of long Tubes; these Tubes arise from the Circumference, and take their Origin from certain Follicles which sustain the Vessels and Nerves which there form a Rete: They advance towards the Middle, and meet in a Sinus covered by a Membrane which has many Apertures; from this Sinus there are Canals which are discharged into the Veins. VANDEN EURYCE has observed lymphatic Vessels which enter there, and others which egress, in order to go to the Reservoir of the Chyle. RIOLAN believed, that the Capsulæ had no other Use than to strengthen the Plexus Reticularis formed by the costal and stomachic Nerve. HIGHMORE will have them to be of no Use but in a Fœtus. VESLINGIUS, with the Antients, thought that they were the Source of the Succus Atrabilarius, which, according to his Opinion, separates the Serum from the Blood. According to SYLVIVUS's and KERKERING's Opinion, this Juice causes an Effervescence in the Blood of the Heart. PETRUCCI was of Opinion, that it stimulates the Bladder, and, by this means, causes the Secretion of the Urine. THOMAS BARTHOLINE affirms, that their Use is to colour the Urine.

MOLINET advanced an Opinion which appears, at first, more probable than all we have already mentioned. He believes, that the Fœtus makes little or no Water: It is not necessary, according to his Opinion; since the Blood of the Mother is de-

depurated. But, in order that no Secretion can be made in the Kidneys, the Course of the Blood must have been disturbed, and a Receptacle must have been given it, before it arrived at the Kidney the Capsulæ from that Receptacle: Therefore it is that they are as big as the Kidneys in a Fœtus. This Opinion has its Difficulties. 1. It is certain, that the Capsulæ Atrabiliaræ must not be looked upon as a simple Receptacle: There had been no Occasion for their wonderful Structure on this Account. 2. It is certain, that there is some Secretion performed in them. We found a Fluid of a yellowish Colour, which returns into the Veins. Besides, had not this Fluid been found, its Structure, resembling that of a Viscera destined for Secretion, would induce us to judge that there is some Matter there secreted. 3. This Opinion supposes that the Fœtus makes no Water: But this cannot be affirmed, till after BIDLOO's Opinion has been disproved. HORNIUS and GRAEF have made the same Observation. 4. We cannot conceive how much small Arteries could intercept so great a Quantity of Blood. BERGERUS makes this Objection. As for the other Proof which he brings against MOLINET, concerning the Defect of the Anastomoses betwixt the Vessels of the Mother and the Fœtus, we shall speak of them hereafter.

The Lymphatics which enter and pass through the Capsulæ gave Rise to Opinions of their serving as secretory Ducts to the Lymph: In all this there is nothing, as yet, demonstrated. In order to find out the Use of the Capsulæ, it must be looked after in a Fœtus: They are very large, as the other Organs which have no Use in Adults. All the Opinions, contrary to this, will be doubt-

* This Author was thought to have found out the Tunica Allantoïdes in the human Fœtus.

ful. We may, by that, judge of BOERHAAVE'S Opinion, who believes, that these glandular Bodies are formed to return the Blood (which comes from the Kidneys) the Lymph which it has lost.

Dr. LIEUTAUD is of Opinion, that the renal Glands secrete a certain acrimonious Blood, which, when diffused into the Vena Cava, may stimulate and accelerate the Circulation, as we know the Blood moves but very slowly in that Vein. See *Essay Anatomique*, Art. xvii. p. 326.

OBSERVATIONS OF LUSUS NATURÆ.

In the Kidneys we often meet with Concretions of terrestrial Particles, sometimes petrified to a large Bulk, and at other Times so as not to be able to pass along the Ureters; which has occasioned some Practitioners to perform Nephrotomy, as they say.

These Organs vary prodigiously, with respect to their Magnitude: Sometimes they both connect; as we read in THOMAS BARTHOLINE'S Anatomical History, Cent. II. concerning those of a Woman; likewise in CASPAR BAUHINE'S Anatomical Theatre, who found the left Kidney in the Pelvis of a Boy, of four Days old, lying immediately below the left hypogastric Artery.

CASPAR BAUHINE makes mention of a young Girl, born of nephritic Parents, who, labouring long under a Suppression of Urine, a Swelling arose, about the Loins, which, having long waited for Suppuration to no Purpose, and finding only an Induration on the Part; a Surgeon boldly cut through the same, and drew out two Stones; after which, her Water came right, as formerly, the Wound being healed up. This History, says he, I had from my Master GULIELMUS CAPELLUS, when I was at Paris. Unde liquet (inquit ille) veram esse, HIPPOCRATIS Sententiam quæ habetur. Lib.

de Morb. intern. calculos nimirum, à lateribus extrahi posse.

But I believe few Surgeons in our Days would attempt such an Operation.

We likewise meet with Kidneys full of purulent Matter. An Instance of this I met with some Time ago, in dissecting a Man who died of an acute Disease, after some Diseases, called *Tabes Renalis*, or Consumption of the Kidneys; they have been found intirely consumed, so as to be no more than a Capsula.

In HALLER's Disputation. Anatomicar. Select. Vol. III. we read, and see the Representation of the Ureters dilated to above an Inch Diameter near the renal Pelvis, and coming less gradually towards the urinal Bladder.

BARTHOLINE relates to have found the Ureters dilated to the Largeness of an Intestine.

The celebrated MALPIGHI, first Physician to Pope INNOCENT XII. who died of an Apoplexy November 29, 1694. On opening his Body, his right Kidney was found half as big as the left; and the Pelvis of the same Kidney three Times larger than it commonly is; which facilitated his voiding many small Stones, which he was afflicted with in his Life-time.

On opening the Body of Mr. COLBERT, Minister of State to Lewis XIV. King of France, many Stones were found in the Ureters.

STEPHEN BLANCHARD, in his XLVth Observation, says, that he found, in a Woman, both the Kidneys so hard and solid, as to resemble Alabaster. The same Author mentions to have found the Kidneys and renal Pelvis full of purulent Matter, in some Bodies, in others full of Stones; and one, in particular, which weighed two Ounces. Vid. Cent. I. Obs. LXXIX.

A DIABETES, from an ill Disposition of the KIDNEYS.

A Man, in the Flower of his Age, being a long Time afflicted with excruciating nephritic Pains, at last his Kidneys ulcerated, and brought upon him a Diabetes. He made no Difficulty in drinking Half a Hoghead of Ale in a Week. After the Death of this Patient, his Relations gave me an Opportunity of opening the Body; in which I found the Viscera very well disposed, except the Kidneys and Ureters: For both the Kidneys were partly consumed, especially the right, the Substance of which was plainly dissolved, and intirely consumed, leaving only its Membranes greatly incrassated and contracted to the Capacity of the Pelvis: The Ureters were also very much distorted, and in many Places dilated, or expanded, more than in others. RUYSEN'S Chirurg. Obs. XIII.

A fatal ISCHURIA, from Stones lodged in the URETER.

How deplorable a Malady of the Stone in the Bladder is, is sufficiently known; but much more cruel is that in the Kidneys, when it is of such a Magnitude as not possible to pass through the Ureter: Because, in this last Case, the Patient can receive no Relief, either from the Skill of the Physician, or Hand of a Surgeon. Of this we had an Instance of a certain Surgeon at Amsterdam, in the Year 1682, who, being for a long Time afflicted with nephritic Complaints, discharged many small Stones; but, at length, fell into a spurious Ischuria, from which he was once relieved by the Use of a Semicupium; but being afterwards seized with most intense Pains of the

Abdomen and Legs, and vomiting black-coloured Matter, at last expired.

On opening the Body, I found two Stones in the right Kidney, and one in the left Ureter; which last was of the Bigness and Figure of an Olive, having its Surface incompassed with small Calculi or Particles of Gravel, which intirely intercepted the Passage of the Urine into the Bladder.

The superior Part of the Ureter above the Stone was very much dilated, by the frequent Passage of Calculi that Way; but below, the Ureter was of its natural Capacity, but more red than it ought to be, having suffered an Inflammation. The Kidney of the same Ureter was also of a monstrous Bulk, and appeared filled; as did also the greatest Part of the Ureter, with an aqueous Humour, the Motion of which the Patient frequently felt, as he told us, upon moving his Body. *Idem*, *Obs.* xv.

The Variations of Nature, which we meet with in Dissection, happens no-where more frequently than in the Vessels of the Kidneys. With respect to the renal Arteries, which are called Emulgents, they are sometimes found double, or triple, at their Origin from the Aorta; from whence, however, they generally arise single: But before these renal Arteries enter the Kidneys, they are variously ramified; being split into two, three, or more Branches. With respect to the Ureters and Pelvis, though we generally observe, that each Kidney is furnished with only one; yet I have sometimes found the Pelvis and Ureter divided into two, or even three. This Pelvis I have frequently observed so much dilated by Stones and Obstructions, that they have been capacious enough to receive the Kidney itself. Although, likewise, the Ureters are generally single; yet, on the contrary, I publickly demonstrated in

a Body, a left Kidney furnished with two Ureters, one of which arose from the superior Part, and the other from the inferior Part of the Kidney: And by freeing these Ureters from their Integuments, I found both of them united into one before their Insertion into the Bladder; and likewise the same Thing has been observed by RIOLAN. Idem, Obs. LXXIX.

An extraordinary Expansion of the KIDNEYS and URETERS of Sheep.

That the urinary Bladder should, by the continual Afflux of that excrementitious Humour, be sometimes distended to an immense Bulk, is not at all surprising, since its membranous Substance, continually receiving the Urine which is there accumulated, may by that means be very much extended. But that the Kidneys themselves should be distended into such an immense Bigness from the Obstruction of the Urine from them, so as to make them resemble urinary Bladders, surpasses all Expectation, and must excite the Admiration of every one. Mr. VOGELIUS, an ingenious Surgeon and Anatomist, brought me two Sheeps Kidneys to be dissected, which were so much distended, and filled with an aqueous Humour, that each of them contained near two Pints. The Ureters were much inflected, and of so large a Capacity, that they would have readily admitted the Root of a very large Parsnep.

The external Surface of each distended Kidney had not lost its natural glandular Substance; but the intermediate Space was composed of a Membrane. Internally the Tabuli of the Pelvis resembled large Cells, of so great a Capacity as to admit a Walnut covered with its green Shell. I could easily press the Urine, contained in the Bladder, towards the Ureters and Kidneys; but

then, to press the Urine back again from the Kidneys towards the Bladder, required a considerable Force; and I found it pass, in a very small Quantity, through a little Aperture in the Middle of a membranous Closure which lay between the Bladder and Ureters. In short, the forementioned Aperture was of such a Nature, that it freely admitted the Urine to pass from the Bladder towards the Kidneys; but, on the contrary, it was almost in vain to attempt a Pressure of the Urine from the Kidneys towards the Bladder: Whence, no doubt, proceeded a Regurgitation of the Urine; and this, in Process of Time, produced such a wonderful Expansion of the Kidneys and Ureters.

DISEASES OF THE KIDNEYS.

An Inflammation of the Kidneys may be known from the burning, pungent, and intense Pain of the Part where the Kidneys are situated; from the acute continual Fever, and the small Quantity of Urine, which is very red, and deep-coloured; or, in the Height of the Disorder, aqueous; a Stupor of the Leg; a Pain of the Groin, Testicles, Ileum, and vomiting of Bile, with continual Eructations.

Such Disorders may be produced by the general Causes of inflammatory Applications to the Kidneys. For, 1. Whatever hinders the Extremities of the Arteries from transmitting their Fluids; a Wound, for instance, a Contusion, an Abscess, a Tumor, a long continued Defluxion, a strong Effort of the Body, or a small Stone. 2. Whatever hinders the Conveyance of the Urine into the Pelvis, Ureters, and Bladder, such as Causes similar to those already enumerated, applied to these Parts. 3. Such Causes as forcibly drive the thicker Parts of the Blood into the urinary Ducts. Violent Running, for instance, hard Riding, excessive Heat, an Effort of the Body, a Ple-

Plethora, acrid Diuretics, and Poisons. And,
4. A long-continued spasmodic Contraction of all those Vessels.

When these Vessels are seized with a violent Inflammation, they are often so constricted, that no Urine can be discharged; or if a small Quantity be evacuated, it is pellucid, thin, and aqueous, which is a very bad Symptom; and the Nerves cohering to these Vessels, and lying contiguous, being often irritated, Pains and Convulsions are produced in the Stomach, Mesentery, Intestines, and Ureters. Hence arise Eructations, Nauseas, Vomitings, Fluxes, Iliac Passions, Retention of Urine, Stupor and Immobility of the Legs, and a preternatural Heat of the Loins.

If the Causes of the Nephritis are so strong and powerful, that the Disorder can neither be removed by Resolution, nor any other Method, but is protracted beyond the seventh Day, and an Abscess is to be dreaded, the Formation of which may be known from a Remission of the Pain, which is succeeded by a Pulsation, a frequently returning Horror, a Weight and Stupor of the Part. That an Abscess is already formed, is obvious, from the former Signs having proceeded from the Pulsation, Heat, and Tension, in the Part; and from the purulent, foetid, and apparently saline and putrified Urine. As soon as we are certain that the Abscess is formed, we are first to use powerfully maturing and emollient Medicines; then, when the Urine appears purulent, we must exhibit Diuretics; but if a small Quantity of the inflammatory Matter remains coagulated in the minute Folliculi of the Urine, it forms a kind of Basis, to which the sabulous Matter of the Urine gradually adhering, forms a Stone in the Kidneys, which is, by Degrees, augmented,

A Nephritis, also, sometimes degenerates into a Gangrene, as is obvious; from the Violence of the Cause and Symptoms; the Want of Relief by Remedies, and the sudden Remission of the Pain, without any apparent Cause, accompanied with a cold Sweat, a weak and intermitting Pulse, a Hicough, and either no Discharge of Urine at all, or an Evacuation of such as is livid, black, full of fœtid Filaments, and rendered unseemly by brown or black Caruncles, and a sudden and considerable Loss of Strength: In this Case, no Medicines are of any Service, either for the Relief or Recovery of the Patient.

From what has been said, it is obvious that there are almost an infinite Number of Species of a Nephritis; that their different Causes are as numerous; that one of these Causes is the Stone; and that, at the same Time, all these different Species are to be cured almost in the same Manner. Hence we understand the Crisis of a Nephritis, and why this Disorder so often happens in Fevers; hence, also, we are enabled to know and cure an Ischury, arising from the Fault of the Kidneys or Ureters. Vid. BOERHAAVE'S Aphorisms, Sect. 993.

WOUNDS OF THE KIDNEY.

Although the Kidney is not particularly specified in this Aphorism of the great HIPPOCRATES; yet have its Wounds been commonly reputed fatal, on account of its Situation, the Blood-Vessels appertaining to it, and its proper Function, or Office: Notwithstanding all which, FALLOPIUS declares, that he had known the left Kidney wounded with a Dagger, and the same healed: GEMMA says, that some Parts thereof were cut away by a Poniard thrust into a Woman's Loins. As also DONÆUS in Schol. ad Cap. XXII. Observ. suarum Medic.

But

But the most remarkable Instances we have had of these Wounds, have been such as have been artfully made for the Relief of nephritic Persons, or those afflicted with Stones in this Part: Among which, I think, none more so than that Relation of PAREY, in Book xxiv. Chap. xix. ex Monstrelati Chronicis, containing the Story of a Malefactor four Miles from Paris, condemned for Theft. The Physicians acquainting the King that many of the Citizens of Paris being miserably afflicted with the Stone, particularly one of his Nobles there named; this Criminal also, as appeared, having long laboured under the same Disease, it was their Request to his Majesty, that a Nephrotomy might be performed, for inspecting, more particularly, the Seat thereof, and making Experiment of the Operation for extracting the Stone; and that his Life might be granted, on that Condition, if he survived the same. Accordingly, at the Command of the King, the Section was made; and the Parts being scrutinized, the Body was afterwards sewed up, and the Prisoner, in a little Time, recovered; having his Life preserved, with great Rewards for his Pains.

But I do not remember to have read of any Surgeon who has made an Attempt to practise it since.

In a Boy, who died of the Stone, I found a double Ureter, each Part being dilated to an Inch Diameter; the Pelvis in each Kidney to twice its natural Bigness, and the Tubuli Urinarii each as large as the Pelvis.

In a Man, who had never been cut for the Stone, I found the Ureters dilated, in some Places, to four Inches Circumference; and in others, but little dilated: And a Stone, which I found in the Bladder, was less than a Nutmeg; which must have fallen
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into several Pieces, or else both Ureters could not have been dilated.

From this, and other like Observations, I think it appears, that the great Size to which the Ureters are usually extended, in People who are troubled with the Stone, is owing to small Stones which stick at the Entrance into the Bladder, until the obstructed Urine, which dilates the Ureters, can force them into the Bladder.

I have, in several Subjects, found one Kidney almost consumed; and, once, a Man with but one Kidney: And I have seen Lymphatics, in a diseased Testicle, as large as a Crow-quill. CHESELDEN'S Anatomy.





LECTURE XII.

Of the URINARY BLADDER.

THE Bladder is a membranous and muscular Substance, capable of Dilatation and Contraction, situated in the inferior Part of the Abdomen, immediately behind the Symphysis of the Offa Pubis, and opposite to the Beginning of the Intestinum Rectum. The Figure of it is nearly that of a short Oval. It is broader on the anterior and posterior Sides than on the lateral Parts; rounder above than below, when empty, and broader below than above, when full.

It is divided into the Body, Cervix, and Fundus; and into an anterior, posterior, and two lateral Parts. The superior Part is termed the Fundus or Bottom, and the Cervix or Neck is a Portion of the inferior Part, which is contractile.

STRUCTURE OF THE BLADDER.

The Bladder is made up of several Membranes, almost like the Stomach. That Part of the external Membrane which covers the superior, posterior, and lateral Sides of the Bladder, is the true Lamina or Membrane of the Peritonæum; and the rest of it is surrounded by a cellular Substance, by the Intervention of which, the Peritonæum is connected to the muscular Membrane.

The proper Membranes are three in Number; one muscular, one nervous, and one villous, which
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is the interior. The muscular Membrane is composed of several Strata of fleshy Fibres, the exterior of which are mostly longitudinal; the next to these are more inclined towards each Hand, and the interior more and more oblique; and they become, at length, almost transverse. All these Fibres intersect each other in various Directions, and are connected by a fine cellular Substance, which may be separated by inflating it.

The nervous Membrane is nearly of the same Structure with the Tunica Nervosa of the Stomach.

The internal Membrane is somewhat granulated and glandular; and a mucilaginous Serum is continually discharged through it, which moistens the interior Surface of the Bladder, and defends it against the Acrimony of the Urine. It appears sometimes altogether uneven on the interior Side, being full of Eminences and irregular Rugæ when empty, and in its natural State of Contraction. These Inequalities disappear when the Bladder is full, or when it is artificially distended by Air, or by injecting any Liquid.

At the Top of the Bladder, above the Symphysis of the Offa Pubis, we observe a Ligament which runs up between the Peritonæum and the Linea Alba of the Abdomen to the Navel, diminishing gradually in Thickness as it ascends: This Ligament, which is of particular Use in the Fœtus, is, in Part, originally a Production of the internal Membrane of the Bladder, and is termed Urachus.

THE UMBILICAL ARTERIES.

They become in Adults like ligamentary Elongations, which are the Extremities of the umbilical Arteries: These Arteries come from the Hypogastrics, run up by the Sides of the Bladder, and remain concave, and filled with Blood, even
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in Adults, as high as the Middle of the Bladder, through all which Space they likewise send off Ramifications: Afterwards they lose their Cavity, and become ligamentary, as they ascend. At the superior Part of the Bladder they approach each other, and, joining the Urachus, form that Ligament, which may be termed the superior Ligament of the Bladder. These are of no Use in Adults; but their Uses shall be explained in the Lecture on the Fœtus.

The external Fibres of the muscular Membrane are more numerous than the internal, and the most longitudinal anterior Fibres form a kind of Incurvation round the Urachus at the Top of the Bladder, much like that of one of the fleshy Portions which surround the superior Orifice of the Stomach and inferior Extremity of the Oesophagus. This Incurvation passes behind the Urachus.

The Portion of the Peritonæum which covers the posterior convex Side of the Bladder, forms a very prominent transverse Fold, when the Bladder is contracted, which disappears when the Bladder is extended: This Fold surrounds the posterior Half of the Bladder, and its two Extremities are elongated towards each Side; by which Elongations a kind of lateral Ligaments of the Substance of the Bladder is formed, which are more considerable in Children than in Adults.

The inferior Part of the Bladder, which deserves the Name of Fundus much better than the superior, is perforated by three Openings, one anterior, and two posterior. The anterior Opening is formed by an Elongation of all the proper Membranes: This Elongation is called the Neck of the Bladder, and shall be described with the Parts of Generation in Men.

The other two Openings in the true Fundus of the Bladder are formed by the Ureters, which in their Course downwards, already described, run behind the spermatic Vessels, and then behind the inferior Part of the Bladder, approaching each other. Each Ureter lies between the umbilical Artery and Vas Deferens of the same Side; the Artery lying on the external Side of the Ureter, and the Vas Deferens on the internal.

Afterwards they creep between the Vasa Deferentia and the Bladder, crossing these Canals; and then, at about a Finger's Breadth from each other, they begin to pierce the Membranes of the Bladder. They run a little way between the muscular and nervous Membranes, and open into the Bladder obliquely, somewhat nearer each other than when they first entered its Membranes.

The Orifices of the Ureters in the Bladder are somewhat oval, and narrower than the Cavity of the Ureters immediately above them. The Edges of these Orifices are very thin, and seem to be formed merely by the Union of the internal Membrane of the Bladder with that of the Ureters.

The Bladder is supplied with sanguiferous Vessels from the Hypogastricæ or Iliacæ Internæ; being Rami of the Arteria Sciatica, Epigastrica, and Umbilicalis, on each Side.

The Nerves of the Bladder come from the Crurales, and also from the Sympathetici Maximi, by means of their Communication with the Crurales: It has likewise some Nerves from the Plexus Mesentericus Inferior.

Besides the Ligaments already mentioned, there are likewise two small ones, by which the anterior Part of the true Fundus of the Bladder is connected to the Offa Pubis, which shall be described with the Cervix and Sphincter.

USE OF THE URINARY BLADDER.

As it was necessary, for the Welfare of the Body, that an excrementitious Fluid should be secreted by the Kidneys from the Mass of Blood, and thence discharged by the Ureters; therefore it was necessary that there should be a Reservoir to receive the Urine, and thereby allow the Animal proper Intervals for the Performance of other necessary Functions. For if there was no such Reservoir, but that the Ureters terminate in the Urethra, there would be a perpetual Dripping of the Urine, as the Secretion is performed, to the no small Inconvenience of the Animal.

Birds and Fowls have no Bladder; but their Ureters are terminated by the Intestinum Rectum, and mixes with the Excrements.

This Reservoir, or Receptacle, is a membranous Sacculus of a flexible Nature, being capable of Dilatation and Contraction, according to the Necessity of retaining or expelling its Contents.

Its internal Membrane is of a delicate nervous Texture, and therefore capable of Irritation, and furnished with innumerable Glands, which secrete a Mucus to guard the Bladder from the too great Acrimony of the Urine: For when any Accident happens to these Glands, as by taking acrimonious abrading Medicines, or by a sharp hectic Blood, which destroys this Mucus, it should be laid bare, we should be liable to suffer exquisite Pain: And though it is thus guarded by the Mucus, yet its Sensation is not quite blunted; that Matter serving also as a Medium through which it is capable of being sufficiently irritated without Pain, as the Cuticula is the Medium thro' which we feel (without Pain) any Substance we touch.

But if this Mucus should, on the contrary, become too much condensed (which is the Case in those

those who have a Lymph loaded with coagulated Salts), it would become hard, and, as it were, incruſted; which would obſtruct the Glands.

From ſuch an Obſtruction, therefore, might proceed an Induration of ſome of the Glands, which, when once begun, the gradual Increate of a ſchirrous Bladder is inevitable, from the conſtant Preſſure and Induration of other Glands by thoſe firſt obſtructed.

Over-long and great Exerciſes will cauſe this Drineſs of the Mucus of the Bladder: For thereby Perſpiration is ſo increaſed, that the more fluid Particles, which ſhould dilute that Matter in the ſecretory Glands of the Bladder, are thrown off through the Pores of the Cutis, and the Mucus left in a very viſcid State; whereby it is as capable of farther Coagulation and Induration, as the White of an Egg.

The Mucus may be alſo over-fluid, or the Tone of the Glands be too much relaxed; whereby great Quantities of that Matter will appear in the Urine of Perſons who imagine themſelves free from any Diſorder: And it may be, and, no doubt, is, often miſtaken for the purulent Matter of an Ulcer in ſome of the urinary Organs; or ſome Weakneſs in the proſtrate Gland, Veficulæ Seminales, or the like: Whereby we might be deceived, and preſcribe what might increaſe the Diſorder.

RIVERIUS calls it a depraved Diſpoſition of the Bladder; and teaches us how to diſtinguiſh it, ſo as to be certain from whence it comes. He ſays thus: That Matter coming away from the Bladder is different from that of any other Part in this, that it is more tenacious and glutinous, and will ſtick to the Sides of the Urinal after the Urine is poured off, and afterwards can ſcarce be ſeparated from the Veſſel: Whereas the Mucus from any other

other Part does not adhere to the Vessel, but comes off with the Urine.

The interior or nervous Membrane is much larger, and more extensive, than any of its Covering; and therefore, when they are contracted, this appears in the Plica, having no Elasticity whereby to contract; and even after the external Integuments are much dilated, there will Rugæ still appear in it.

This is of wonderful Use. For supposing that, by any Accident, the Urine was detained in the Bladder longer than ordinary, so that the external Membranes were upon the Stretch; it was highly necessary that the nervous Tunic, being so sensible of Pain, should still have some Plica to spare, that there might be more Time to promote the Discharge of Urine by proper Application. Because, if this Membrane be extended as soon as the others, Convulsions would follow, inevitably, the Rugæ. Therefore from the Rugæ, we may also account for the Receptacles in which Stones are sometimes found in the Bladder.

Where a tenacious Mucus abounds, and one or more Stones happen to be stuck between two Plicæ, they are glued to the Stone, and a slight Inflammation happens; which causes the Villi of that Membrane to shoot out, and extend themselves over the Stone, whilst the Mucus itself grows still more tenacious, and has often the Appearance of a Membrane. This made TULPIUS say, that two Stones, voided by a Woman, had Membranes round them, which were nothing but Mucus condensed and dried about them.

Thus may Stones acquire membranous Productions round them in the Bladder, and thereby become inseparable from it; and when these Villi do not shoot out to cover them, yet they may have mucous Coverings which dry into a kind of Mem-

brane, either adhering to, or separate from, the Bladder. When the Bladder is taken out of the Pelvis, and inflated, then the Rugæ of the internal Membrane disappear: Because, when the muscular Membrane is thus distended so much as to obliterate the Plica in the nervous Tunic, it has no more Power to contract itself as before; and, consequently, when the Air is let out, all the Membranes and Muscles collapse together. The same will be the Case in those who, being subject to the Stone, and very frequent Obstructions of Urine, have the Bladder often distended by Repletion; and its Elasticity weakened by the long Use of irritating acrimonious Medicines: And there can be no greater Sign of Injuries having been done to the Bladder, than (upon taking it out of the Body without inflating) finding its whole Compages relaxed, and cutting into it, finding the Rugæ obliterated. See the ingenious Dr. PARSONS's Description of the Urinary Bladder, &c.

OBSERVATIONS ON THE NATURE OF URINE.

Before we explain the Nature of Urine, we must look into the different Forms under which this Fluid makes its Exit. It varies, according to the Aliments we take, and according to the Passions and Times. When we drink much, it resembles Water, is deprived of Taste and Smell, and can easily be retained; but when we have eat, and the Chyle is separated from the Aliments, it is coloured, lesser in Quantity, and has some Smell. It is not then so easily retained, because it irritates the Sides of the Bladder by its Acrimony. When the Chyle is changed into Blood, it is redder, and not in so great a Quantity: Its Acrimony augments and irritates more the Fibres of the Bladder. Lastly, When, by Abstinence, the Blood is not

renewed, the Fluids are heated in the Body, the Urine is not so clear as those we have spoken of, it alcalises sooner, and consequently is more acrimonious, more disposed to putrefy, and less in Quantity.

These are the Substances which the Urine is composed of: 1. There is a real Water. 2. An acrimonious Salt, very subtil and volatile, like an Alkali. 3. A very volatile Oil, which is disposed to putrefy. 4. A Caput Mortuum, which has been very much attenuated by these Substances, and the Motion of the Circulation.

The Water of Urine is insipid. We may be convinced of this in letting it evaporate: We observe no Smell nor Taste; yet there remains a very subtil Part of the foetid Oil, which cannot be separated from it. This is the Reason why the Water rather deserves to be called Spirit, than Phlegm.

The Salt of the Urine is neither acid or alcali; it is an acrimonious ammoniacal Salt. If there is any fixed Salt found, it is Sea Salt, which is made Use of in Aliments, and changes not its Form except in the human Body, while the more fixed Salts are intirely changed. The Oil of the Urine is but a Portion of the Fat which has been subtilised: It is very different from all other Oils.

The Caput Mortuum is mixed in the Substances we were speaking of. When it is separated, it is insipid, fixed, and white.

The Mixture of these Substances compose different Sorts of Urine, according to their different Proportions: These are the Qualities with which it should be endowed when the Body is in a State of Health; the Colour must be that of a Citron: In those who have a Fever, it is reddish, or of a very deep Colour; in hypochondriacal People, and Women subject to the Vapours, it is white.

The Smell, according to TECMEYER, must be like that of Violets: But if it were so, we should but very seldom find natural Urine. BELLINI had more Reason to say, that it should have almost no Smell at all.

The Smell really cannot proceed but from the Salts which tend to be alcalised, and from the Oil's tending more to a Putrefaction. All this is contrary to the natural State of Fluids in the Body.

As for the Sound of Urine, when it falls into the Urinal, it must be like that of common Water.

In order to have a thorough Knowledge of all which concerns the Urine, we must examine from whence arises its Colour. When the Phlegm is evaporated, 1. It becomes yellower. 2. It appears redder. 3. Blackish. In changing from one Colour to another, it takes a deeper, and becomes always thicker, and more saltish: At last there remains a viscous Substance, which, in the Bottom of the Pot, seems to be of a pretty dark Colour; but if we rub the Surface of the Pot with it, it gives it a fine yellow Colour.

The Urine being thus evaporated, we may pour Water upon it. According to the Quantity of Water poured upon it, the Urine will have the same Colours we were just now speaking of: It will be the same as before its Evaporation; and will have the same Smell and Taste. It will putrefy, thicken, and precipitate to a Sort of Tartar.

According to this Experiment, the Urine is more or less coloured, or saltish, according to its greater or less Quantity of Phlegm; by which we shall be able to give an Account why the Urine is of a different Colour in different Ages, Climates, and Passions; and why the Urine of those who are of a hot Constitution is coloured. 1. Because
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there is a great Evaporation made of the aqueous Substance by Transpiration; therefore there must be less Phlegm in that which is filtrated by the Kidneys. As the Blood is more agitated in its Vessels, the oleaginous Matter, being more divided, will pass easier; the contrary of which happens in old People. By only applying these two Reasons to other Causes which vary the Urine, it will appear, that in hot Climates, and violent Passions, as Anger, the Urine must be very much coloured.

There are three Things to be observed in the Urine. 1. A Sediment of Matter which is precipitated at the Bottom of the Vessel. 2. A Substance which is suspended in the Urine, and goes by the Name of Anæorama. 3. A Substance which is like a Cloud. The Sediment is nothing else but an earthy Substance mixed with the Salt of Urine: When there is a Motion in the Substance of the Urine, or, rather, whilst the Heat rarefies the gross Parts, these Matters are there suspended; but when the Cold contracts them to a lesser Bulk, they are precipitated. When these Substances have been very much rarefied, then they are sustained in the Urine, and form what is in Latin called Suspensiones: The Clouds are nothing but the same Substances rarefied in such a Manner that they occupy the superior Part of the Urine. These Principles suffice to make us judge of all the rest.

We may have Room here to ask three or four Questions. 1. Whether the Urine comes from the Blood? 2. Whether it is equal to, or above, the Quantity of the Liquor which we drink? 3. Whether we may judge of Maladies by Urine? In order to void, by the Substances which circulate with the Blood, they must pass from the Intestines into the lacteal Vessels, from thence into the Receptaculum Chyli, and at last into the Veins,

Heart, Kidneys, and Bladder. It is already demonstrated, that there is no other Way : So that the Urine comes from the Blood.

By this means we may explain, 1. Why, when we have been agitated by violent Motions, we void Blood, though there is no Stone in the Kidneys. The Blood, being violently propelled, dilates the secretory Canals, and passes off with the Urine. 2. It appears also, by this, why Heat, Motion, Sweat, and Abstinence, make the Urine red, acrimonious, saltish, and nauseous : The Blood then loses its aqueous Particles. The Heat which is produced by Motion disengages the Salts, and attenuates the Oil : It must then deposit a coloured Fluid in the Kidneys, more saltish and foetid, than the Blood itself ; because in its Vessels it is mixed with more viscous Substances, and more heated, than in its Ducts.

Some Physicians were of Opinion, that the Urine is more in Quantity than the Liquor which we drink : But this is inconsistent. All the Aliments which we use are filled with Juices : Thus Urine may surpass, in Quantity, the Liquor we drink. Nevertheless, according to Transpiration, other Evacuations, and Diseases, the Quantity of Urine diminishes or increases.

Some Quacks pretend to know Diseases by the Inspection of Urine only : But this is impossible. 1. In order to do this, it is necessary that every Disease, according to the Part affected, should impress a particular Character on the Urine ; which is impossible. 2. They must also know exactly the natural State of Urine in every Subject : Because there are Persons whose Urine is like that of sick People when they even enjoy a perfect State of Health. 3. The Air alters Urine soon after it has been discharged from the Bladder. 4. The venal Tubes are sometimes very much dilated ;
which

which make great Alterations in the Urine, tho' the Persons are very well. 5. The State of the Blood cannot be known by Urine; because the Heat, Age, Aliments, and Passions, change it, from Time to Time: We shall not be able to judge of the Distempers which attack the Solids by it; and yet, in malignant Fevers, the Pulse and Urine will appear as good as in those who enjoy a perfect State of Health

The Urine forms Stones in the Bladder and Kidneys. They have Recourse to divers Hypotheses in order to explain this Phænomenon: Some have ascribed it to a petrified Fluid; others to chymical Mixtures: There are others, also, who have asserted, that the Stone is formed in the same Manner as those stony Incrustations which are found in Vessels where there has been Water a long while boiling, or in the same Manner as the Tartar which subsides in Hogsheds.

FERNEL explained the Formation of the Stone best. He says, that there is no Stone formed in the Bladder unless there be a Kernel which serves for a Basis. Round this there are Strata of a viscous Substance. There is really observed in almost all Stones, a Substance in the Strata which contain it.

NUCK's Experiment, made by other Anatomists after him, confirms this Opinion. This Anatomist opened the Bladders of several Dogs. He there put a Sort of Substance like Cloth: Some Time after, having again opened the same Bladders, he found, that there was a real Stone formed round that Substance. This being laid down, if the Blood abounds with terrestrial Matter, a Part of that Matter will remain in the Kidneys or Bladder. If the Bladder is lax, as in Infants; or inflexible, as in old People; this Matter will not be expelled: So that the Strata of a viscous Matter will be

formed round it. As for the Sand which is in the Urine, it is nothing else but the terrestrial Particles concreted and separated from the Oil. I have sometimes seen whitish Concretions which resembled Mortar, and smelled very strongly.

This is almost all that can be said of the Urine, and the Strainers through which Nature has made it pass.

The Animal Oeconomy cannot be deprived of this Secretion without Disorder. It is true, the Tubuli, which secrete the Sweat, could supply it, in some measure; yet, when the Urine is closed in the sanguinary Vessels, it causes Convulsions, Lethargies, and Apoplexies. Sometimes the Urine, thus gathered, is dissipated through the Pores which serve for Transpiration.

SALMUTH gives an Account of a Man's swelling all over his Body after a Stoppage of the Urine, caused by nephritic Pains. The Sweat dissipated the Matter which caused the Swelling, and facilitated the Exit of the Stone. [See Physical Essays on the Parts of the human Body, and the animal Oeconomy.]

It does not seem that there is any other Way for the Urine to pass to the Bladder than from the Kidneys and Ureters. Though we know that the Stomach, like other Membranes, exhales a Moisture through its Tunics; and though it is not improbable, from Experiments, that the Bladder also absorbs; and though the Passage of mineral Spaw Waters, by Urine, be extremely quick; yet it does not thence follow, that there must be Ways, different from that of the Ureters, to convey the aqueous Portion from Digestion to the Urinary Bladder.

As the Bladder is, on its whole Circumference, separated from the abdominal Cavity by the Peritonæum; nor is it very likely that the Vapours, which

which either egress from the Bladder, or are derived towards it from other Parts, can here find open Pores through the Peritonæum; nor do Membranes imbibe much which has been macerated for any Time, so as to fill their Pores with Humours: And if we consider attentively the Manner in which mineral Waters are discharged by Urine, it is demonstrable, that there is no such Rapidity therein as is commonly imagined: But the Stimulus of cold Water drank, does, like the external Cold applied to the Skin, cause a Concussion of the Bladder and urinary Parts, by which they are solicited to repeated Discharges of that Urine which was first in the Body, and not that which was immediately drank.

Moreover, the Largeness of the renal Vessels demonstrate, that not much less than an eighth Part of the Blood sent to the Body is received at a Time; and, consequently, there are above a Thousand Ounces of Blood conveyed through the Kidneys in an Hour. Whence it will appear but a moderate Allowance for Twenty-five Ounces of Water secreted from so great a Quantity of Fluids. It is certain, that, both in Man, and other Animals, the Urine will putrefy, if the Ureters are obstructed by any means: Therefore it can pass into the Bladder. HALLER'S Prim. Lin. Physiol.

OBSERVATIONS.

A Man of Fifty-five Years of Age, who was thought to be troubled with the Stone, could not retain above three or four Spoonfuls of Urine in his Bladder; which obliged him to make Water very often, and in the Evacuation he felt severe Pains. As the Patient complained of no other Symptom which could indicate that it was a Stone, I was doubtful whether it was that Distemper, or not; and presumed, that his Bladder might have been

been contracted, or be in an inflammatory State, since he drank plentifully of Wine.

I probed him carefully, and found no Stone. I then ordered him to be let Blood four Times, prescribed him a regular Diet and emollient Pti-fans, with Injections, &c.

For the Space of a Fortnight the Bladder, which at first was capable of containing only two Spoonfuls of Injection, resumed, by degrees, its natural Capacity; which I knew, by the Quantity of Injection admitted without causing Pain. LE DRAN's Obs. in Surg. LXXX.

An Excrescence or Tumor arising between the internal Tunics of the Bladder, is a Disease very uncommon; and hitherto no one has attempted the Cure of it by Extirpation: Nor, indeed, can it be supposed that the Instances are frequent, where the Operation is practicable.

A Woman, of Twenty-three Years of Age, on the Twenty-fourth Day of June, 1747, strained herself, by endeavouring to lift a great Weight. She was immediately seized with a Pain in the Small of her Back, and a total Suppression of Urine; which Symptoms, notwithstanding the various Methods used for her Relief, continued till the Twenty-ninth of the same Month; when an eminent Physician, and Man-midwife, was called to her Assistance; who drew off her Urine with a Catheter. In April, 1750, she applied to Mr. WARNER; whom (after proper Inquiry) she told, that, ever since the Accident, she could not void a Drop of Urine without the Assistance of a Catheter.

She was in continual Pain, and had lately been weakened by having, at several Times, lost considerable Quantities of Blood, occasioned by the introduced Catheter.

On examining her Meatus Urinarius, I discovered a considerable Tumor, which seemed to be of a fleshy Substance, and to take its Rise from the inferior Part of the Bladder near its Cervix; and it protruded a little way out of the urinary Passage, upon straining to make Water.

Seeing this, I dilated the Passage by Incision; when, by pulling the Tumor forwards, I had sufficient Room to tie it. On the sixth Day after this Ligature was made, the Tumor dropped off. It was nearly equal to a Turkey's Egg, both in Bulk and Shape.

After the first Day of the Operation, she voided Urine without any Instrument, and is now perfectly well recovered. See Mr. JOSEPH WARNER'S Cases in Surgery.

HALLER tells us of a Merchant who had all the Symptoms of the Stone in the Bladder, yet none could be felt by the Catheter; but, after his Death, two large Stones were found, each inclosed in a Membrane in the Bladder. Vid. De Morb. Intern. Scholiograph.

MARTIN HOLTZAPPEL gives an Account of a Nobleman who was searched, and no Stone felt; yet he was cut, and still the Surgeon could feel no Stone. He died the eighth Day; and when the Bladder was taken out of his Body, Thirty-two Stones were found, the smallest of which were as large as a Bean, and the largest weighed Half an Ounce, all alike in Colour, and every one involved in a distinct Membrane, which filled the whole Capacity of the Bladder, except a small Passage for the Exit of the Urine. SKENK. de Ves. Urin. Obs. cclxix.

TULPIUS, in Lib. III. Obs. cclxix. mentions a Senator of Amsterdam who had Twenty-nine Stones, of different Sizes and Figures, found in his Bladder, each of which was wrapped up in a kind

kind of Capsula. The same Author relates the Case of ISAAC CAUBON, whose Bladder he calls Vesica Ringosa, in which a vast Number of Stones were found invested with Membranes. Vid. JOH. JACOB. MANGET. Theatrum. Anatom. Tom. I.

STEPHEN BLANCHARD opened Bodies wherein the Urinary Bladders were ulcerated with the Intestinum Rectum, and others full of purulent Matter, with Stones invested in Capsulæ.

The like Account we read in GUILHELM. FABRIC. HILDANUS's Observations, &c.





LECTURE XIII.

Of the ORGANS of MAN subservient to GENERATION.

THE Parts of Generation in Males are of different Kinds; some of them being wholly contained in the Abdomen, and others externally. From this Situation, they might properly enough be divided into external and internal Parts; and all those belonging to the first Class might be described before those of the second.

But it is still more proper to have a Regard to the Oeconomy of these Parts, according to which their Functions begin in some internal Parts, are continued in some external Parts, return again to the internal, and are finished in the external.

SPERMATIC VESSELS.

The spermatic * Arteries arise most commonly from the anterior Part of the inferior Aorta near each other, and about an Inch lower than the Arteriæ Renales. Their Origin oftentimes varies, as I have observed them to arise from the renal Artery; and sometimes they exit higher, lower, or

* They ought more properly to be called testical Arteries, as they do no more than the others in conveying the Blood to be secreted.

more laterally, than is common; and each Artery has been seen to arise from other different Places.

They run down obliquely in the posterior Part of the Abdomen, within the cellular Substance of the Peritonæum, passing insensibly from behind forward, and so parting gradually more and more from the Aorta, they cross over the anterior Side of the Ureters, and run through the Apertures of the abdominal Muscles along with the Elongations or Productions of the cellular Portion of the Peritonæum.

They are small at their Origin, and in their Course downwards, and give off pretty considerable lateral Ramifications to the Membrana Adiposa, Peritonæum, and also to the Mesentery, where they seem to communicate with the mesenteric Arteries.

They sometimes pass through the Areolæ of the spermatic Veins; and before they egress from the Abdomen, they are divided into very fine Rami, which run, in a more or less winding Course, almost parallel to each other.

Afterwards they enter the cellular Productions of the Peritonæum, which serve them for Vaginæ. They do not fluctuate indifferently from one Side to the other of these Vaginæ, but are connected along their inner Surface by thin membranous Laminæ, which are likewise Continuations of the cellular Substance of the Peritonæum.

The Arteries continue the same winding Course within these Vaginæ; passing before the Vasa Deferentia, which are likewise contained in them, and at length terminate, by Ramifications, in the Epididymes and Testes.

The spermatic Veins accompany the Arteries, and have nearly the same Course. The right Vein arises commonly from the Trunk of the Vena Cava, in the same Manner as the Artery from the Aorta :

Aorta: And I have sometimes observed it to rise from the Union of the right renal Vein with the Vena Cava; and sometimes I have seen three Veins on the right Side egress separately from the Trunk of the Vena Cava: The left spermatic Vein arises commonly from the left renal Vein.

In their Course they first join the Arteries, and, together with them, enter the cellular Productions of the Peritonæum, to which they are connected in the same Manner: From their Origin to their Passage through the Apertures of the abdominal Muscles, they send off several Rami to the Membrana Adiposa of the Kidneys, Peritonæum, and Mesentery, where they seem to communicate with the Venæ Mesaraicæ, and consequently with the Venæ Portæ.

A little below the Place where they traverse the Ureters, they send out a considerable Branch, which is afterwards divided into two Rami, one of which communicates with the Vena Capsularis, and the other oftentimes with the Renalis; and lower down they give out the Vein, which communicates with the Vena Mesaraica, as already mentioned.

They differ from the spermatic Arteries, not only in that they are bigger, and their Tunics thinner; but also in being more divided and multiplied, as they descend to the Apertures of the abdominal Muscles; and as they gradually produce a large Fasciculus of Ramifications (which the Antients named them) with the Arteries, Vasa Pyramidalia.

These Ramifications often communicate with each other in this Course, and form a great Number of Areolæ, Contortions, and Convolutions, so as to represent a kind of Plexus, which is connected to the cellular Vagina of each Side by very fine Lamellæ; and the Artery which accompanies the Vein crosses it in several Places, and runs thro'
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the Areolæ in different Directions. These frequent Convolutions have given Rise to the Name of Vasa Pampiniformia, formerly given to these Vessels; and their particular Adhesions to each other at some Places made it believed, that there were real Anastomoses between the Artery and the Vein.

LEAL LEALIS, an Italian Anatomist, not considering the lateral Ramifications of the spermatic Arteries and Veins, thought he was able to demonstrate these pretended Anastomoses. The Experiments made by him, on living Animals, prove nothing to the Purpose. His Way was, to make a common Ligature on both Vessels, a little above the Testicle, and another on the Trunk of the Vein, after he had emptied it; then pressing the Aorta, to force the Blood into the spermatic Artery, the Vein, which he had before emptied; was found to be presently filled.

From thence he concluded, that the Course of the Blood to and from the Testicle, being obstructed by the inferior Ligature, there must be some Anastomoses between the two Ligatures, through which the Vein was supplied with Blood. But it is very plain, that this Effect was owing to the lateral Ramifications of the spermatic Artery and Vein, and not to his pretended Anastomosis. These fine lateral Ramifications were well known to EUSTACHIUS, but had escaped LEAL LEALIS.

TESTES.

The Testes * are two glandular Bodies, situated near each other, without the Abdomen, below the
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* These Organs are not always lodged within the Abdomen in the Peritoneum in a Fetus, as HALLER inserted in his Prim. Lin. Physf. but only sometimes they remain, tho' very rarely, concealed in the inferior

Interstice between the Groins in an Adult. The Antients named them Didymi, or Gemini. Their Size is nearly that of a Pigeon's Egg, and they are of an oval Figure, a little flatted on each Side. We may consider in each Testicle two Extremities, two Margins, and two Sides: One Extremity is situated anteriorly, and a little superiorly, the other posteriorly, and a little inferiorly; and their Margins lie superiorly and inferiorly.

At the superior Margin they have each an Appendix, called Epididymis, together with which it is involved in several Coverings; and they are both suspended in a common one called the Scrotum.

Each Testicle is a spermatic Gland formed by a vast Number of fine whitish Tubuli, folded and twisted in different Manners, and distributed in various Fasciculi, between membranous Septa; and the whole being surrounded by a strong common Covering, named Tunica Albuginea.

These Septa are disposed longitudinally, divaricating from each other on one Side, and approaching on the other. They approach each other along one Margin of the Testicle, and terminate in a long narrow whitish Body, as in a kind of Axis.

From thence they divaricate in a regular Manner, and are fixed by their opposite Margins on the interior Surface of the Tunica Albuginea, of which

inferior Part of the Abdomen, particularly in young Subjects; which have been taken for Tumors, or inguinal Herniæ: And, though improperly, Bandages were applied for that supposed Disorder, which were of very bad Consequence.

We read in BLASIUS's *Observ. Med. Rarior.* of a Man of Thirty Years of Age, who was said to have three Testicles; viz. two on the right, and one on the left Side, each of which had its particular Vessels, and the same Bulk of Conformation.

The same Author says, he met with, in a Subject which had three Kidneys, two in the left, and one in the right Side; and each had its particular Ureter.

they appear to be a Continuation. This white Body may be termed the Nucleus of the Testicle*.

From this Description we see, that all these Septa are not of an equal Breadth; that the Interstices between them are in some measure triangular; and that the Extent of the small Tubes, which lie therein, must be very considerable. They have been reckoned to amount to many Ells †, by taking the Sum of all their several Portions; and they may be easily unfolded by a long Maceration, which destroys the delicate Substance by which all their Folds and Convolution are connected.

All these Tubuli seem to terminate, by a smaller Number of common Trunks, at the white Body or Nucleus already mentioned; which Trunks afterwards pierce superiorly the anterior Extremity of the Testicle, and are disposed in several Folds along the lateral external Part of the superior Margin, all the way to the posterior Extremity. From this Union arises a long whitish plaited Fasciculus called Epididymis.

The Epididymis thus formed, may be reckoned a Production of the Testicle, or a kind of Testis Accessorius; and it resembles, in some measure, an Arch supported by its Center. It is more contracted in the Middle than at the Extremities, by which it is closely united to those of the Testicle.

Between its Extremities it does not immediately touch the Testicle, but is only loosely connected to it by the Duplicature of a very fine and almost transparent Membrane, as by a kind of Ligament. This Membrane is the Continuation and Dupli-

* First described by HIGHMORE; whence it is named Corpus Highmori.

† BELLINI says about three Hundred; but they are more easily to untwist in Rats, than any other Animal I knew of.

cature of the Tunica Albuginea; which, having supplied the Place of a Ligament to the Epididymis, afterwards invests it.

The Epididymis is flat, a little concave on the inferior Side, or that next the Testicle, irregularly convex superiorly, or on that turned from the Testicle; and these two Sides are distinguished by two angular Margins; by the interior of which it is connected to the Testicle in the Manner already said, but the external Margin and flat Side are loose and free.

The anterior Extremity or Head of the Epididymis arises from the Testicle; and the posterior Extremity, which likewise adheres very closely to it, is incurvated from the posterior to the anterior, and a little superiorly, and contracting, by Degrees, forms a particular Canal called Vas Deferens.

The Scrotum is the cutaneous Tegument of the Testes. Externally it is common to both, formed by a Continuation of the Skin of the adjacent Parts, and commonly very uneven, having a great Number of Rugæ on its external Surface. Interiorly it forms a muscular Capsula for each Testicle, called Dartos.

The exterior or cutaneous Portion of the Scrotum is nearly of the same Structure with the Skin in general, of which it is a Continuation; only it is somewhat thinner, and is likewise plentifully furnished with sebaceous Glands, and Bulbs or Roots of Hairs.

Though it is a common Covering for both Testicles, it is, nevertheless, distinguished into two lateral Parts by a superficial and uneven prominent Line, which appears like a kind of Suture, and from thence has been termed Raphe.

This Line is a Continuation of that which divides, in the same Manner, the cutaneous Tegument of the Penis, and it is continued thro' the

Perinæum, which it divides, likewise, all the Way to the Anus. It is only superficial, and does not appear on the Inside of the Skin.

The interior Surface of this cutaneous Saccus is lined by a very thin cellular Membrane, through which the Bulbs and Glands appear very distinctly when we view its Inside. It increases in Size, chiefly, according to its Length; and then the Rugæ disappear, more or less, according to the Degrees of the preternatural State or Indisposition.

DARTOS.

The Dartos, or muscular Portion of the Scrotum, is a true cutaneous Muscle; the Fibres of which are, for the most part, strongly connected to the Skin, running through the cellular Substance which lies between these two Portions instead of a Membrana Adiposa, but without the least Appearance of Fat. This Muscle is thin, and, by the Disposition of its Fibres, forms a Capsula with two Cavities, or two small Bags joined laterally to each other, and contained within the cutaneous Portion.

The lateral Parts of these two Capsulæ, which are turned from each other, are longer than those which are connected; and by this Union a Septum is formed between the Testes, which may be called Mediastinum Scroti.

The Raphe or Suture, already mentioned, adheres to the Edge of this Septum, and thereby braces down the Middle of the cutaneous Portion, which from thence appears to have, in Part, two Cavities; and this, perhaps, was what gave Occasion to make the French Word for the Scrotum to be in the plural Number. The other Edge of the Septum adheres to the Urethra.

The two Capsulæ of the Dartos are lined, on the internal or concave Side, by a cellular Substance
more

more considerable than that between the convex Side and the Skin; so that the muscular Fibres, all the Way to the Septum, lie between two cellular Strata. They run through the external Stratum, as has been said, to be inserted in the Skin, and by their Contraction they form the natural Rugæ of the Scrotum.

These fleshy Fibres have likewise a strict Connection with the internal cellular Membrane, especially at the superior Part below the Groin, where the anterior and external lateral Portions of the Dartos terminate by a kind of tendinous or ligamentary Expansion, which is strongly united to the internal cellular Membrane. This is as a particular Fascia Lata, which gives Insertion to the Portions of the Dartos just mentioned, and as a broad Frænum which keeps the same Portions together.

The aponeurotic or ligamentary Expansion of the Dartos is fixed in the Ramus of the Os Pubis, between the Musculus Triceps and the Origin of the Corpus Cavernosum of the same Side (which shall be described hereafter), all the Way to the inferior Part of the Symphysis of these Bones. The internal Portion of these muscular Capsulæ, or that which forms the Septum Scroti, is fixed to the Urethra by means of a Communication between the same ligamentary Expansion and another; which shall be explained in its proper Place.

VASA DEFERENTIA

Are two white, solid, flattened Tubes, one lying on the right Side, the other on the left. From the Epididymis (which they are Continuations of) each of them runs up, in the cellular Vagina of the spermatic Vessels, as high as the Apertures in the abdominal Muscles; the sanguiferous

Vessels lying forwards, and the Vas Deferens behind them.

This Fasciculus, thus formed by the sanguinary Vessels, Vas Deferens, and their common Covering, is termed the Spermatic Cord. The Covering is smoother on the external than on the internal Side, and for that Reason it has been looked upon as a Vagina; the internal Substance of which is most cellular, and connects all the Vessels together, while the external forms a Covering to invest them.

The Vas Deferens, having reached the membranous Lamina of the Peritonæum, where that Lamina runs over the Orifice of the Vagina, separates from the sanguiferous Vessels, and runs posteriorly, in Form of an Arch, in the cellular Substance of the Peritonæum, as far as the nearest Side of the Bladder.

It passes afterwards behind the Body of the Bladder, to which it adheres very closely, as also to the Lamina of the Peritonæum which covers it, and then continues its arched Course towards the Cervix of the Bladder, where both Vasa Deferentia meet, and their Curvatures terminate.

In this Course the Vas Deferens passes behind and crosses the neighbouring umbilical Artery, and crosses the Extremity of the Ureter of the same Side in its Passage between that Extremity and the Bladder; then, having got behind the Bladder, it meets the Vas Deferens of the other Side between the Insertions of the Ureters, and they run down together to the Cervix of the Bladder.

This Canal, which at the Origin of the Epididymis is pretty large and plaited, becomes, immediately afterwards, smaller and smoother, and continues in that Form till it arrives behind the Bladder,

der, where it begins again to be larger and more uneven.

It arises from the angular Portion or posterior Extremity of the Epididymis, and from thence runs anteriorly, in a very oblique Course, on the half posterior Part of the Epididymis, where it is a little incurvated as it joins the posterior Portion of the spermatic Vessels.

The Texture of the smooth Portion of this Canal is very solid, and, in a Manner, cartilaginous, especially near the Surface of its Cavity, which, though very narrow, is still kept open by means of the Solidity and Thickness of its Sides.

The Cavity of the Vas Deferens is cylindrical, though the whole Tube is flat, and its external Circumference oval, as may be seen by cutting it transversely; and the Cavity enlarges as it passes behind the Bladder. The Termination of these Canals must be referred to the Description of the Urethra.

The particular Coverings of the Testes are commonly called Tunics; and they are three in Number: The Tunica Musculosa, named Cremaster, Vaginalis, and Albuginea. The two first are common to each Testicle, and to the spermatic Vessels which belong to it; and the third is peculiar to the Testicle alone.

The Tunica Vaginalis is the most considerable of the three, and must be described first, in order to conceive the Structure and Connection of the Cremaster, which is very improperly called a Tunic. The Albuginea has been already described with the Testes.

The Tunica Vaginalis is a Continuation of the Vagina of the spermatic Vessel, which, as it approaches the Testicle, is gradually dilated; and forms two Capsulæ, one contained within the other, the external being the longest and broadest

at the Bottom; so that there is a void Space left between them, in which the Testicle is lodged.

This Structure may likewise be explained in the following Manner: The Vagina, having reached as low as the Testicle, is divided into two Laminæ, the interior of which is the Bottom of the Vagina, and the exterior is expanded round the Testicle, and gives it that Tunic called Vaginalis.

The internal Surface of this Tunic is lined by a fine Membrane, which strengthens the Bottom of the Vagina, and forms a kind of Diaphragm, which prevents all Communication between the Vagina of the spermatic Vessel and the Tunica Vaginalis of the Testicle.

The Cremaster, improperly termed a Tunic, is a thin muscular Membrane, which runs down round the Vagina of the spermatic Vessel, and terminates in the Tunica Vaginalis of the Testicle.

It surrounds almost the whole Vagina, and afterwards expands itself on the superior and external Part of the Tunica Vaginalis, into which it is inserted, and terminates.

It arises partly from the Ligamentum Fallopii, and partly from the inferior Margin of the internal oblique Muscle of the Abdomen; and on this Account it seems sometimes to arise from the Spine of the Os Ilium; and it is probable that the Musculus Transversalis likewise contributes somewhat to its Formation.

It is covered by a very fine cellular Membrane, detached from the external Side of the Aponeurosis of the Obliquus Externus, round the Opening commonly called the Ring. This Membrane is lost in the cellular Substance of the internal Side of the Dartos.

From all this we see, that the Cremaster is rather a Muscle of the Tunica Vaginalis, than a particular Tunic. Those among the Antients who
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believed it to be a Tunic, called it *Tunica Erythroïdes*, from a Greek Word which signifies red; but this Muscle is not always red, neither is that Colour essentially necessary to a fleshy Substance.

The *Corpora Cavernosa* are two ligamentary and very limber Tubes, united laterally to each other, through the greatest Part of their Length, and solid at their two Extremities, two of which are connected, and rounded like the End of a Finger; the other two divaricate, like the Branches of the Greek Υ , and diminishing gradually in Size after the Divarication, terminate in an oblique Point. These divaricated and pointed Extremities may be called the Roots, and the round Extremities the Heads.

These two Bodies are almost cylindrical; being round, and of an equal Diameter from the Roots to the Heads; where they are, in some measure, conical. The ligamentary Substance of their Sides is elastic, and composed of fine compact Fibres, which are partly transverse, and partly more or less oblique.

The Cavity of these ligamentary Tubes is intirely lined by a strong cellular or cavernous Substance, which does not seem to be a Continuation of the lateral one. These Cells communicate with each other, and are always more or less full of Blood, resembling, pretty much, the cellular Substance of the Spleen; only with this Difference, that the Sides of the Cells are thicker in these cavernous Bodies, and without any additional Substance.

By the Union of the two *Corpora Cavernosa*, two external Sinuses are formed; one on the superior Side, the other on the inferior. The inferior Sinus is somewhat broader than the superior, and is filled, through its whole Length, by a third Tube,

Tube, narrower than the Corpora Cavernosa, called the Urethra.

The Roots of the Corpora Cavernosa are each fixed to the Margin of the small Ramus of the Offa Ischium and Pubis. They meet at the Symphysis of the Offa Pubis, where each of them becomes a cylindrical Tube, and unites with the other in the Manner already said.

The Heads, or rounded Extremities, connect the Basis of a distinct Body, called the Glans, which is an Expansion of the Urethra, and closely united to it in the Manner which shall be explained.

By the Union of the Corpora Cavernosa from their Roots to their round Extremities or Heads, a particular Septum is formed by the transverse Fibres of both. Between the Fibres of this Septum, several small void Spaces are left, by which the Corpora Cavernosa communicate with each other; and therefore, by blowing into one of them, we presently inflate the other. Towards the rounded Extremities, the Septum diminishes every Way.

The Urethra is the third spongy Tube which composes the Penis, and adheres to the Corpora Cavernosa through the whole Length of the inferior Sinus formed by their Union. It differs from the other two, both as it is narrower, and as it forms a concave Canal. Its Substance is spongy or cavernous, except a small Portion next the Bladder, and its internal and external Surfaces are membranous.

It is, at first, no more than a membranous Canal continued from the anterior Opening of the Bladder at the Place called the Neck, which is a Name that would be more proper for this Portion of the Urethra.

About a Finger's Breadth and a Half from its Origin, it connects a cavernous Substance like that of the two other Tubes, only smaller, which surrounds it through the whole Extent of the inferior Sinus of the Corpora Cavernosa.

But before this spongy Substance begins to surround the Urethra, it forms a distinct oblong Body which is connected only to the inferior convex Side of the Canal, and afterwards, being divided on each Side, invests it quite round: This Body is called the Bulb of the Urethra; being larger than any other Part of that Canal, and divided interiorly, by a very fine membranous Septum, into lateral Parts; and therefore, when it is inflated, it appears to be double, or with two Heads.

The first Portion of the Urethra, or that which is not covered by the cavernous Substance, and which, from the Bladder to the Bulb, is only a membranous Canal, is sustained by a large, solid, whitish Mass, of the Figure of a Chesnut, situated between the Bladder and the Bulb of the Urethra, its Basis being towards the Bladder, the Apex towards the Urethra, and the Sides lying superiorly and inferiorly.

This Body is named the Prostates, from a Greek Word which expresses its Situation before the Vesiculæ Seminales, and implies a Plurality, because it appears to be divided into two lateral Lobes by a concave Sinus, which runs through its superior Side from the Basis to the Apex. The first Portion of the Urethra lies in this Sinus, adhering very closely to the Prostates which surround it.

The Body of the Prostates lies on the Intestinum Rectum, and the Apex is under the internal Labium of the cartilaginous Curvature of the Ossa Pubis. The internal Substance is spongy, but very compact; and in each Lobe there are several Folliculi which open into the first Portion of

the Urethra, towards the Bottom of the Sinus, as shall be shewn. The small Portion of the Urethra between the Apex of the Prostates and the Bulb, perforates the interosseous Ligament of the *Ossa Pubis*: This Portion is very short, its Length being no more than what is sufficient to pass thro' the Foramen in the Ligament, the posterior Side of which, consequently, touches the Apex of the Prostates, and its anterior the Bulb of the Urethra. This Portion might be called the Cervix of the Urethra, and that which lies between the Body of the Bladder and the Prostates might be called, more properly, the Cervix of the Bladder.

The spongy Substance of the Urethra, having reached the Extremity of the *Corpora Cavernosa*, forms a large Head, called the Glans, which crowns the three spongy Pillars; with this Difference, however, that it is a Continuation of the spongy Substance of the Urethra, and only adheres to the Extremity of the *Corpora Cavernosa* without any direct Communication.

It is for this Reason, that, if we blow into the spongy Substance of the Urethra, the Glans is presently inflated, and no Air passes into the *Corpora Cavernosa*; but when we blow into one of these Bodies, the Air passes immediately into the other, the Urethra and Glans remaining as they were.

The Figure of the Glans is that of a rounded Cone, a little flattened inferiorly, and with an oblique prominent Basis, the Circumference of which is somewhat greater than that of the *Corpora Cavernosa*.

The spongy Substance of the Glans is thick and uniform next the *Corpora Cavernosa*, but next the Urethra it is perforated by a Continuation of that Canal, and is there no thicker than the Urethra before the Formation of the Glans.

There-

Therefore the Canal of the Urethra does not lie in the Middle of the Glans, but continues its direct Course through the inferior flat Side of it towards the Extremity, where it terminates by an oblong Orifice.

All the convex Surface of the Glans is covered by a fine villous Substance, and again by a fine Membrane resembling the red Part of the Lips. The Circumference of the Basis of the Glans has a double Row of small Papillæ, which may be reckoned sebaceous Glands, from which a thick Matter is discharged.

We have several Things to take Notice of in the Cavity of the Urethra, at the Bottom of which, the first Portion, or that which lies within the Prostates, there is a small, oblong, oval Eminence, pretty large on the posterior Part, and terminating anteriorly in a Point, called Caruncula, or Verumontanum. The large Portion of it is commonly perforated by two Apertures, sometimes only by one, and very seldom by three; and these are the excretory Orifices of the Vesiculæ Seminales. Each Orifice has a small thin membranous Margin, which may serve for Valves to the excretory Ducts of the Vesiculæ.

On each Side of the large Portion of the Caruncula there are five or six Apertures, ranked in Form of a Crescent round its lateral Parts, which are the Orifices of the excretory Ducts of the Prostates which come from the Folliculi already mentioned, and run in an oblique Course to the Orifices, in a kind of membranous Duplicature.

The Vesiculæ Seminales are soft whitish Bodies, about three or four Fingers Breadth in Length, one in Breadth, and about three Times as broad as thick, situated obliquely between the Rectum and the inferior Part of the Bladder, in such a Manner, as that their superior Extremities are at a Distance
from

from each other, and their interior Extremities united between those of the Vasa Deferentia, of which they imitate both the Obliquity and the Incurvation.

They are irregularly round superiorly, and their Breadth decreases gradually from thence. By the Union of their interior Extremities they form a kind of Fork, the Branches of which are broad, and bent like Rams Horns: These Extremities are very narrow, and form a small Cervix, which runs behind the Bladder towards its Orifice, and continues its Course in the Sinus of the Prostates, through the Substance of the contiguous Portion of the Urethra, till its Extremities pierce the Caruncula in the Manner already said.

The internal Substance of the Vesiculæ is plaited, and, in a Manner, distinguished into several Capsulæ by contorted Folds. Their external Surface is covered by a fine Membrane which serves for a Border and Frænum to the Folds, and is a true Continuation of the cellular Substance of the Peritonæum. The Vesiculæ may easily be unfolded, and all their Contorsions streightened; and, by this means, they become much longer than in their natural State.

Their inner Surface is villous and glandular, and continually furnishes a particular Fluid, which exalts, refines, and perfects, the Semen, which they receive from the Vasa Deferentia, and of which they are the Reservatories, for a certain Time.

The Passage of the Vasa Deferentia into the Vesiculæ is very particular. It has been already observed, that these Canals are incurvated behind the Bladder; and that their contracted Extremities unite at that Place. They unite in an Angle, and run between the contiguous Extremities of the Vesiculæ; and this Union is so close, that the
ad-

adhering Portions seem to form only one middle Septum, between two small Tubes, each of which is formed partly by the Extremity of one Vas Deferens, and partly by that of the neighbouring Vesicula.

This lateral Union of the Extremities of the Vas Deferens and Vesicula Seminalis on each Side, forms likewise a kind of short Septum, which terminates in a Crescent, like a small semilunar Valve, and the Extremity of the Vas Deferens is narrower than that of the Vesicula. By this Mechanism, the Fluid contained in each Vas Deferens has Liberty to enter the contiguous Vesicula; but that contained in the Vesicula cannot return into the other Canal*.

Afterwards the two small Tubes, each formed by the Extremities of the Vas Deferens and Vesicula, run in between the Basis of the Prostates and Canal of the Urethra; and perforating the Sides of that Canal obliquely, they terminate in the Caruncula in the Manner already said.

The Inside of the Canal of the Urethra is lined by a fine Membrane full of capillary Vessels, and its Surface is perforated by a great Number of oblong Apertures, or small Lacunæ, of different Sizes, the largest lying near the Glands.

These Lacunæ, or Orifices of the excretory Ducts of the same Number of small Glands, are dispersed through the Substance of the Urethra; which Ducts run, for some Way, in the spongy Substance, along the convex Side of the internal Membrane of the Urethra, and open obliquely, from behind forwards, into the great Canal. The

* If we blow into one of the Vasa Deferentia, after having compressed the Urethra, the Air inflates the contiguous Vesicula Seminalis and the Bladder of Urine, without passing into the Vesicula, or Canal of the other Side, except we blow with too great Violence.

Margins of the Lacunæ are femilunar, or like a Crescent, because of the Obliquity of their Opening.

A little way from the Beginning of the cellular Substance of the Urethra, we meet with two Lacunæ more considerable than the rest, and their Ducts are very long: These Lacunæ and Ducts lead to two glandular Bodies, situated on the two convex Sides of the spongy Substance of the Urethra near the Bulb. Each of them is about the Size of a Cherry-stone, but they are oblong and flat, and covered intirely by the Muscles called Acceleratores. These two Bodies are commonly called Prostatae Inferiores; but if their Situation be carefully examined, they will be found to be higher than the true Prostates. There is a third Body of the same kind situated more anteriorly.

The Cavity of the Urethra resembles, nearly, that of a small writing Pen. It is not every-where round; and towards the Gland becomes broader and flatter on each Side, especially in the Gland itself, where there is a kind of oval or navicular Fossula.

This Canal terminates at the Extremity of the Glans by a narrow oblong Orifice, or Fissure, which is much less than the rest of the Cavity: The Commissures of this small Fissure are turned one towards the convex, the other towards the flat Side of the Glans, and the Labia of the Fissure are its lateral Parts; and it seems to be surrounded by fleshy Fibres.

The Integuments which cover all these Parts are three or four in Number. The first is the Skin, with the Cuticula; the second is the common cellular Membrane, which, in this Place, seldom contains any Fat; the third is termed nervous; and the fourth is a particular cellular Membrane, which is not always to be found.

The

The first of these Integuments, the Skin, is a Continuation of that of the Pubis and Scrotum, and adheres to the second all the way to the Basis of the Gland where that second Integument ends. The rest of the cutaneous Integument covers the Glans without Adhesion, and terminates by an Opening: This Portion is named *Præputium Posterius*; and along the whole inferior or back Side, both of the whole Integument in general, and of the *Præputium* in particular, there runs a fine Suture, which is a Continuation of the Raphe of the *Perinæum* and *Scrotum*.

The internal Surface of the Prepuce is lined with a fine Membrane from the Opening all the way behind the Basis of the Glans, and the same Membrane is folded from behind forward, round the Glans, forming the proper Integument thereof, and covering, very closely, its whole villous Surface as far as the Orifice of the Urethra, where it joins the Membrane which lines the Inside of that Canal.

This proper Membrane of the Glans, and internal Membrane of the Prepuce, form conjointly along the flat Part of the Glans; from its Basis to the Orifice of the Urethra, a membranous Duplication, which is like a Septum or Mediastinum, divides this Part into two lateral Portions, and limits the Motions of the *Præputium*; for which Reason it is called *Frænum Præputii*.

The Surface of the internal Membrane of the Prepuce discharges a Fluid which prevents it from adhering to the Glans, and perhaps serves likewise to dilute that which is collected at the Basis of the Glans, from the *Glandulæ Sebaceæ* already mentioned.

The second common Integument of these Parts is nearly the same with what is every-where found

under the Skin, except that it is not filled with Fat, and that it is more fibrous than cellular, and a little loose. It accompanies the Skin to the Basis of the Glans, as has been already observed.

The third common Integument, improperly called *Tunica Nervosa*, is of a firm, elastic, ligamentary Substance, and its Fibres are sometimes of a yellowish Colour. It invests the *Corpora Cavernosa* and *Urethra* from the Glans to the Symphysis of the *Ossa Pubis*; and at some Distance from these Bones, it forms, on the superior Sinus of the *Corpora Cavernosa*, a close Duplication: By this Means, a flat broad Ligament is raised, which runs directly superiorly, and is inserted in the forementioned Symphysis, as far as the tendinous Basis of the abdominal *Musculi Pyramidales*.

This Ligament has been called *Ligamentum Elasticum*, because it yields, and recovers itself; and *Suspenforium*, because it suspends these Parts by means of its Insertion into the Symphysis. It sends off a Detachment, or *Ala*, towards each Side, one Margin of which is fixed between the *Musculus Triceps* and the *Corpus Cavernosum*, and forms the ligamentary Expansion in which the *Dartos* is inserted, as has been already said. It seems likewise to send down another Elongation directly to the *Perinæum* and *Anus*.

The fourth Integument of these Parts is the *Tunica Cellulosa* of *Ruysch*, which immediately surrounds the *Corpora Cavernosa* and *Urethra*, lying between these and the third Integument, from which it seems to be distinguished only by the Closeness and Fineness of its Texture; and it is sometimes hardly perceptible.

The Muscles that are inserted in these Parts, are five Pairs: Two for the *Corpora Cavernosa*; two for the *Urethra*; two common Muscles, called
Trans-

Transversales; and four small ones for the Prostates.

The first two Muscles are commonly called Erectores, but might be more properly named Ischio-Cavernosi: The next two are called Acceleratores; but the Name of Bulbo Cavernosi would better agree with them: The four small Muscles, two of which are superior, and two inferior, may be called Prostatici. It was observed, at the Beginning of the Description of the Muscles, that the Names, taken from the supposed Uses, are very equivocal.

The Musculi Ischio-Cavernosi lie along the Roots of the Corpora Cavernosa; each of them being fixed by one Extremity very obliquely, in the internal Labium of the Ramus of the Os Ischium, from the superior Tuberosity: From thence it accompanies the Root of the Corpus Cavernosum all the way to the Symphysis of the Ossa Pubis, and is fixed, by its other Extremity, in the Corpora Cavernosa, near their Union; where the Fibres of both Muscles meet, and are reciprocally expanded over both Corpora. They lie a little lower, and more interiorly than the Roots of these cavernous Bodies.

WINSLOW describes two other Musculi Accessorii, which he looked upon as lateral Acceleratores, or as Acceleratores Accessorii; fixed lower, and more interiorly, in the Os Ischium, than the former, which they accompany all the way to the Corpora Cavernosa; and then, leaving them, they are inserted chiefly in the Urethra, near the Bifurcation of the Musculus Bulbo-Cavernosus.

These Bulbo-Cavernosi, commonly called Acceleratores, form, first of all, a penniform Muscle, by means of a middle Tendon, fixed in the inferior Part of the interosseous Ligament of the Ossa

Pubis, and to the Union of the Musculi Transversales, with the Sphincters of the Anus; from which they pass, in an expanded Form, over the Bulb of the Urethra, covering that Bulb and the Urethra itself, and adhering, in some measure, to both, as high as the Origin of the Ligamentum Suspensorium, the middle Tendon answering to the Septum of the Bulb.

Afterwards the two Laminæ separate, and run obliquely to the right and left Hands from behind forwards, and from below superiorly; surrounding the Corpora Cavernosa, into the external Sides of which they are inserted. The middle Tendon adheres very strongly to the inferior Part of the Septum of the Bulb, in which, and in the Urethra itself, several of the Fibres of these Muscles are fixed.

The Musculi Transversi, called also Triangulares, are two long, narrow, fleshy Fasciculi, inserted each, by one Extremity, in the Root or Beginning of the Ramus of the Os Ischium; from whence they run, transversely, along the Margin of the interosseous Ligament of the Ossa Pubis, as far as the Apex of the Prostates, where their other Extremities meet, and commonly form a kind of digastric Muscle, the Middle of which gives Insertion to the Muscles of the Urethra, and to the cutaneous Sphincters of the Anus.

The superior Prostatici are two thin Lamellæ fixed in the superior Part of the interior Side of the small Rami of the Ossa Pubis, from whence they are spread over and inserted in the Prostates. Their Insertions in the Ossa Pubis are on one Side of those of the Obturatores Interni.

The Prostatici Inferiores are small transverse Laminæ, each of which is fixed in the Symphysis, between the Ramus of the Os Pubis and Os Ischium,

chium, and from thence runs transversely till it meets its Fellow from the other Side under the Prostates, to which they are both strongly connected; and they serve like a Girth to sustain these Glands. They may be considered as two small or internal Transversales, and the other two Transversales may be distinguished by the Names of great, or external: They have likewise some Adhesions to the Point in which all these Muscles, hitherto described, are united.

The ARTERIES of these Parts come chiefly from the internal Iliacs or Hypogastrics, and the rest from the Iliacæ Externæ or Crurales. The principal Arteries are termed Pudicæ; one of which is external, the other internal.

The Pudicæ Externæ send a Branch to each Side, which, having passed out of the Pelvis by the Side of the Os Sacrum, runs on the internal Side of the Tuberculum Ischii to the Roots of the Corpora Cavernosa, along the internal Side of the Musculi Ischio-Cavernosi, or Erectores. It sends Ramifications to the bulbous Head of the Urethra, and to the Corpora Cavernosa; and, together with the Glutæa, with which it communicates in its Passage, it likewise supplies the Scrotum.

The Pudicæ Internæ, having furnished the Intestinum Rectum, Bladder, Vesiculæ Seminales, and Prostates, communicate with the Hæmorrhoidales, pass under the Curvature of the Ossa Pubis, partly enter the Corpora Cavernosa, and partly run along the superior Side; sending off small lateral Branches, which surround these Bodies, like irregular Semicurvatures, and penetrate them by numerous Ramifications.

The crural Arteries send each likewise a Branch, which, running behind the contiguous crural Vein, is distributed to the Integuments of the Penis, by

the Name of *Pudica Externa*, and communicates, by lateral Ramifications, with those of the *Pudica Interna*. These Communications are not only between the internal and external *Pudicæ* of the same Side, but also between those of both Sides, which reciprocally communicate with each other.

The Distribution of the Veins follows nearly that of the Arteries, but they have more Ramifications and Communications, as in other Places. The principal Vein is that which passes directly under the Symphysis of the *Ossa Pubis* between the two Arteries, and runs along the whole superior Sinus formed by the Union of the *Corpora Cavernosa*. It is very large, often double, and very seldom triple; but the Trunks do not separate whilst in the Sinus; and it has a great Number of Valves.

This great middle Vein is formed by the Union of the hypogastric Branches, which, after passing on the two internal Sides of the Pelvis, meet about the Middle of the Curvature of the *Ossa Pubis*; where we observe a venal Plexus, which covers the superior convex Side of the first Portion of the Urethra, before it is surrounded by the spongy Substance.

The spermatic Vessels, already described, from their Origin and Termination out of the Abdomen, having reached, on each Side, near the Testicle, are divided into two principal Fasciculi, one of which is larger than the other. The largest is the anterior, and is distributed through the Testicle by a prodigious Number of very fine capillary Ramifications, which accompany all the Convolutions and Folds of the small Canals.

The other Fasciculus is posterior, and distributed to the Epididymis in the same Manner.

The spermatic Artery is accompanied by a Ramus of the epigastric Artery, which runs down, on the Side of it, as far as the Testicle, where they communicate reciprocally with each other. There is sometimes a small Ramus of the hypogastric Artery, which accompanies the Vas Deferens to the Epididymis, and there communicates with the Arteria Spermatica.

The Nerves of these Organs come from the Lumbares and Sacri, and communicate with the Sympatheticus Maximus and Plexus Mesenterici. Near the Curvature of the Os Pubis they form together, on each Side, a particular Branch, which passes under that Curvature along the superior Side of the neighbouring Corpus Cavernosum, near the Artery already mentioned.

In their Passage over the Corpora Cavernosa, they send off a great many Rami, which surround these Bodies on all Sides, between the Skin and ligamentary Integument; being so disposed, as that the Arteries lie between them and the middle Vein. They must be examined presently after the Skin has been raised; because, when the Ramifications are dried by the Air, they disappear.

There are two Nerves which accompany the spermatic Vessel; one of which comes from the Nervi Lumbares, near the anterior Spine of the Os Ilium, which is incurvated in its Passage out of the Abdomen through the Muscles, and serves to distinguish the Cremaster; the other comes from the Plexus Renalis.

There is likewise one Nerve on each Side, which, being produced from the Union of the second, third, and fourth Pairs of the Nervi Sacri, especially from the third, goes out of the Abdomen above the Ligamentum Ischio-Sacrum, passes by the Inside of the Tuberosity and small Branch of the Os Ischium, and is distributed to the Corpora

Cavernosa, the Muscles belonging to them, and to the adjacent Parts*.

The Erection of the Penis is commonly said to be by the Compression of either its large or small Veins, which every-where open within its cavernous Substance, to hinder these Veins from absorbing and returning the Blood from the Arteries.

However, it may be effected, 1. By the levator Muscle drawing up the prostate Glands; but it is very probable, that, as we see in the Nipples of suckling Women, and in the Blushing or Redness of the Face, and Passions of the Mind; from these it is probable, that the Course of the Blood through the Veins may be retarded, without the immediate Use of any Muscle; that is, by the latent Power of a Multitude of small nervous Bridles, by whose Constriction, from the Force of Pleasure, the Veins are compressed and streightened, so as to return less Blood, at that Time, than what is brought in by the Arteries. But the Cause of this Constriction in the nervous Bridles or Sphincters themselves, depends on a various Irritation of the Nerves of the Penis and Urethra, either from an external Friction, or venereal Thoughts.

A long-continued and violent Erection is commonly followed, at last, by an Expulsion of the Semen; when, at length, the cellular Spaces of the Urethra, and its continuous Glands, which are at last filled, become so far distended with a large Quantity of warm Blood, that the nervous Papillæ, stretched out in the latter, become violently affected from the Irritation, or otherwise; which causes the Vesiculæ to void the Semen by the levator Muscles of the Anus, which press them

* The Semen Masculinum shall be explained in the Lecture upon Conception.

against the resisting Bladder with a convulsive Motion, excited either by a voluptuous Imagination, or a Pruritu, which is exquisite in the Nerves of the Glans. Wherefore the Semen is never discharged with the Urine, in a good State of Health; because its Expulsion requires the Bladder to be constricted. For, whilst flaccid, it affords little or no Resistance to the Vesiculæ Seminales. At the same Time, with the Levatores, acts the Compressor of the prostate Gland, and the transverse Muscles; soon after, the contractive Powers of the Urethra are, from the Irritation of the very sensible Fabric of this Canal, put into Action. This Contraction conduces principally from the accelerator Muscles, which makes a powerful Concussion to the Bulb and adjacent Part of the Urethra, so as to propel the Contents more swiftly, in Proportion as the Bulb has a larger Diameter than that of the Urethra.

But this may act firmly on the Sphincter of the Anus, in Conjunction with that of the Bladder, it must be well closed up. The accelerator Muscles seem chiefly to be concerned in the Erection, by compressing the Veins of the Corpora Cavernosa of the Urethra at the same Time with the other Muscles belonging to this Organ. Thus the Semen is ejected impetuously. This Action is like Convulsions, when too frequently and freely practised, weakens the whole Habit, and therefore very much injures the nervous System. HALLER.

SHEBBEARE says*, in imagining that the Blood is the Cause of the Erection of the Penis, there is yet no Reason assigned why it is not always erect; or, when it is, how it becomes flaccid after-

* See his Practice of Physic; wherein he endeavours to shew, that all the Functions of the animal Oeconomy are caused by Degrees of Heat, or Fire, as he called them,

wards; and why the Blood passes through it sometimes, and not always. So that, in saying the Blood is the Cause of this Erection, without telling how it is done, is no Explanation at all. Here, I think, is a farther Proof of the vital Fire's acting in us. The Mind, then, being excited, either from Love, or whatever else may cause it, to the Act of Venery, the vital Fire passes to the Corpora Cavernosa, and distends its Cells in the same Manner we see it at the Time of Erection.

Now if the Blood passes into the Corpora Cavernosa, it must be by means of this vital Fire's first distending these Cells; otherwise it would not always pass. But I believe that it never does pass at all; and that the whole Distension is owing to the vital Fire.

This perhaps may be the Reason, why all Animals, after Coition, are dull, &c. the vital Heat, which, as has been explained, is the Cause of Motion, being diminished by the Vigour of this Action, which demands more than the common Offices of Nature; there succeeds, for a few Moments, a small Faintness about, and a Dejection from, the Want of a sufficient Quantity of Heat to give it the usual Dilatation. And this also will assign some Reason why a Repetition of the venereal Act depends on the Health and Vigour of the Person; and why it cannot be repeated ad libitum; viz. The vital Power, being too much exhausted, and the Fluid in the Cells of the Corpora Cavernosa dissipated by the repeated Action; and both these are in Proportion to the State of Health.

Thus it may be easily conceived how the Penis becomes erect at certain Times, and at other Times flaccid, by means of the Presence or Absence of the vital Heat.

Professor DU VENÉY was the first who took Notice that the spermatic Arteries arise from the
Aorta,

Aorta, which is itself placed under the interior Lamella of the Peritonæum on the external Surface of the Cavity of the Abdomen; but that the Peritonæum, being equally expanded on all Sides, forms a Cavity, in which the abdominal Viscera are contained; but that the Aorta is situated under the Extremity of that Cavity. But we see, that the spermatic Vessels are likewise placed on the external Surface of the Membrane of the Peritonæum, in which Manner they pass through the Apertures of the abdominal Muscles, which here leave the Orifice for the Course of the spermatic Vessels. These Apertures are covered by the Peritonæum, which yet does not pass through them together with the Vessels which it serves only to cover: Therefore the Peritonæum is here extremely thin, and liable to true Herniæ, extended into a Sacculus without bursting; which Sacculus, being protruded by the Sides of the feminal Vessels, enters the Scrotum without including those Vessels. When this Sacculus contains Water, it is called an Hydrocele, Pneumatocele, Omentum, Epiplocele; or if any Portion of the Intestines, an Enteroccele.

From hence it evidently appears, why Herniæ happen so frequently in these Parts; and that the Disorder is nothing else than a Dilatation, with Protrusion, of the Parts through the Apertures of the abdominal Membranes, so as to form a Sacculus, or Cavity, which is improperly called a Rupture; since the Peritonæum is only dilated laterally into the Form of a Bag.

From hence it is easy to conjecture, why those, who are subject to this Disorder, are frequently sterile; as the spermatic Vessels often adhere to the hernial Sacculus; which, if thrust into the Abdomen, the Testicles are, at the same Time, drawn up, whence Convulsions follow.

OBSERVATIONS.

Diseases of the Scroti are a Collection of extravasated Lympha, or Serum, lodged in the cellular Membrane of the Scrotum, and are divided into two Kinds; viz. one produced by Filtration, or Transudation; the other by Effusion. Of the first Species is that where the Urine fills only the cellular Texture of the Scrotum and the Tunica Vaginalis; the other Kind of Hydrocele is when the Lympha is collected in a single Cavity, as in a Cystis; which sometimes causes the Scrotum to be extended as large as the Bladder; which, if not soon remedied, will prove of very bad Consequence to the Testicles, &c.

The Spermatocoele is a Disorder which arises from an Obstruction of the Semen in the Vas or Vasa Deferentia, most commonly proceeding from venereal Diseases; I suppose by the Communication of the lymphatic Vessels.

The Testicles, and their Integuments, may be affected with the same Diseases as the other soft Parts; and, besides these, they have likewise Disorders peculiar to themselves. They may proceed from external Causes; as Blows, Compression, Puncture, Incision; or they may arise from a general vitiated State of the Fluids; and sometimes from a simple Obstruction only; the Fluids being then no otherwise in Fault, than merely from a Defect in their Circulation: At other Times they are produced from a Change in the State of these suppressed Fluids, and oftentimes from a critical or symptomatical Defluxion upon these Parts, proceeding from a venereal or cancerous Virus.

A Disorder of the Testicles, therefore, may be simple: It may become otherwise by the Corruption of the Fluids which stagnate there; and, if
arising

arising from an internal Virus, it may be complicated with other Symptoms proceeding from the same Taint.

Most Authors have comprehended all these Diseases under the general Name of Sarcocoele; as if, in Consequence of such Diseases, the Testicle became a fleshy Substance, and troublesome no other ways than by its increased Bulk: But daily Experience shews us, that these Disorders are very different one from another; and we see that even each particular Species of them is liable to many Changes and Alterations: Those which appear most simple, and are produced by external Causes, sometimes degenerating into a Carcinoma and a Cancer.

These Disorders, in their first Appearance, cannot, without Difficulty, be distinguished, as to their Nature, unless the true Cause be discovered by preceding Circumstances, or by their being attended with some other Illness arising from the same Source. In general, therefore, it is from their Progress, only, that we are able to discover their true Characters. This Progress of theirs may be more or less quick, and in their Consequences more or less considerable: Thus the Tumor may remain a long Time schirrous, without increasing much; or it may increase in a little Time, and still retain the Nature of a Schirrus. It may change likewise, very soon, to a carcinomatous State; and may not degenerate into a Cancer but imperceptibly, and after a long Continuance. The Swelling, as it increases, may also extend to the spermatic Vessels: And this is what is most to be apprehended; especially if it is disposed to carcinomatous, or is become so by the Corruption of the Fluids therein confined.

I have known the spermatic Vessels very much enlarged, and sometimes hardened, not only under
the

the external Apertures, but also extending considerably higher into the Abdomen: In other Cases I have observed, that these Vessels seemed sound from the Testicle to the Aperture; but, by tracing and carefully feeling it through the Skin and the abdominal Muscles, I have discovered some small Tumors, here and there, shaped like Olives, proceeding from the same Cause, and being of the same Nature with the Disorder of the Testicles: I have likewise seen another Instance of these Tumors which grew within the Cavity, and, swelling even to the Size of one's Head, killed the Patient in less than six Months. LE DRAN's Surgery.

The most common Diseases of the Penis arise from a Coition with infected Women, which generally afterwards proceeds from Gonorrhæas, Shancres, or inguinal Buboës.

This Distemper begins, and makes its Progress thus, sooner or later, according as the Woman, with whom the Man has had Conversation, was more or less infected; and likewise according to the Constitution, which in some are more apt to receive than others.

The first Symptoms are; the Patient is seized with Pains in the Genitals, and a kind of Sensation like a Rotation, in the Testicles: Afterwards, if the Prepuce is constantly over the Glans, there arises an Eruption, or Pustules, which, in Sizes, Colour, and Figures, resemble Spots of the Measles; presently after appears a weeping yellowish Matter, till at length, if the Disease be highly virulent, it assumes a greenish Hue, somewhat like a thin sanious Matter.

These Pustules at length become Ulcers commonly called Shancres, which continually corrode the Parts whereon they are fixed; and, if proper Care be not taken, they harden, and become callous,

Some-

Sometimes the Urethra is eroded and exco-riated by a long Running of acrimonious Pus, which creates a soft spongy Substance to supply the Defect; which, by continually increasing, forms Caruncles or Carnosities, which very often obstruct the urinary Passage.

It likewise often happens through some violent Motion, or ill Management of a Gonorrhœa by the Use of Astringents too soon, which hinder a proper Discharge, that the Disease falls into the Scroti, and inflames the Testicles.

We may add here the Phymosis, which Disease is a Contraction of the Prepuce over the Glans; which, being inflamed, cannot be drawn back from the Glans of the Penis.

The Paraphymosis is the reverse of the Phymosis, which is the Prepuce's being contracted, and cannot be brought to cover the Glans of the Penis.

There are also sometimes aqueous Vesicles, named CrySTALLINES.

Women are very near subject to as many Symptoms as Men; their chief Complaints being a Difficulty of making Water, with a Running: Nevertheless, they are liable to Shancres and venereal Warts, as well internally as externally, on the Parts of the Labia Pudendi; likewise to Buboës, and a Constriction of the Sphincter of the Vagina, constructing the external Orifice, as a Phymosis in Men.

The true Communication of this Infection is absorbed by the lymphatic Vessel, and obstructed in the adjacent Glands of the genital Parts first, and proceeds oftentimes, gradually, into the whole Mass of Blood, and not into the cellular Membrane, as BOERHAAVE imagined. In some Cases, where the Penis has become cancerous, either from

venereal Diseases, or otherwise, Amputation has been practised with Success.

RUYSCH has given us an Instance of this in his xxxth Observation; WARNER, Case xxvii. of his Practical Observations in Surgery, has done the same; and I myself, about three Years ago, amputated the Glans of a Penis which was so much shancred that it could not be cured.





LECTURE XIV.

Of the ORGANS subservient to GENERATION in FEMALES.



THE Parts of Generation, in Females, are divided into external and internal; and they are all subordinate to one principal called the Uterus: The other internal Parts are, the Tubæ Fallopianæ, Ovaria, Vasa SpermatICA, Ligamenta Lata, Ligamenta Rotunda, and the Vagina or Canal of the Uterus. The external Parts are, the Pubes, Alæ, Nymphæ, Clitoris, Orifice of the Urethra, and the external Entrance to the Orifice of the Uterus.

The Pubes is that broad Eminence at the inferior Part of the Hypogastrium, between the two Inguina, on which Hairs grow, at a certain Age; and almost of the same Kind with those found under the Axillæ. This Eminence owes its Thickness to the Membrana Adiposa which covers it anteriorly, and some small Portions of the adjacent Muscles.

The longitudinal Cavity, which reaches from the Middle and inferior Part of the Pubes, within an Inch of the Anus, was by the Antients called Sinus; and the lateral Parts of it Alæ, which is a more proper Name than that of Labia, commonly given to them. The Places where the Alæ are joined above and below, are

named Commissures; and may likewise be called the Extremities or Angles of the Sinus.

The Alæ are more prominent, and thicker superiorly than below, and lie nearer each other inferiorly than superiorly. They are chiefly composed of the Skin, cellular Substance, and Fat. The exterior Skin is a Continuation of that of the Pubes and Inguina. It is more or less even, and furnished with a great Number of glandular Corpuscles, from which a whitish ceruminous Matter may be expressed; and, after a certain Age, it is likewise covered, in the same Manner, with the Pubes.

The internal Side of the Alæ is somewhat like the red Portion of the Lips of the Mouth; and it is distinguished every-where from the external Side by a kind of Line, in the same Manner as the Lips from the rest of the Skin; being likewise thinner and smoother than the external Skin. A great Number of Pores are observable in it, and also numerous glandular Corpuscles which furnish a Liquor more or less sebaceous; and these Corpuscles are larger near the Margins than in the other Parts.

Near the internal Margin of the inner Surfaces of the Alæ, on each Side of the Orifice of the Canal of the Uterus, we find a small Aperture more visible than the rest: These two Apertures are called Lacunæ; and they communicate, by two small Ducts, with the same Number of follicular Bodies lying in the Substance of the Alæ, and may be looked upon as small Prostates answering to the Glandulæ Prostaticæ in Males. When pressed, they discharge a viscid Liquor.

Above the superior Commissure, a thin flat Ligament runs down from each small Branch of the Ossâ Pubis, which penetrates the Fat in the Substance of each Ala, and is insensibly lost therein near the Margin. These may be looked upon as
the

the Ligamenta Suspensoria of the Alæ. The inferior Commissure of the Alæ is very thin, or like a membranous Ligament; and, together with the adjacent Parts of the Sides, forms a Fossula called Navicularis, or Scaphoïdes. The Space between the inferior Commissure and Anus, called Perinæum, is about a Finger's Breadth in Length.

The other external Parts are situated in the Sinus, and hid by the Alæ. Directly under the superior Commissure lies the Clitoris, with its Covering, called Præputium; a little lower, in the Orifice of the Urethra, is the Vagina. The Circumference of this Orifice is bordered either by a membranous Circle called Hymen, or by fleshy Portions named Carunculæ Myrtiformes. On each Side of the Clitoris begins a very prominent Plica, like a Crista, which runs down obliquely on each Side of the Orifice of the Urethra; these Plicæ are called Nymphæ, and they might likewise be named Cristæ Clitoridis. On each Side of the great Orifice lies the small prostatic Lacunæ, which, in Coition, sometimes evacuate a great Quantity of a Fluid that has been taken, by the Antients, for the Semen Fœmineum; and they are also the Seat of a Gonorrhæa, as the Prostates in Men.

The Clitoris appears, at first Sight, like a small imperforated Gland. Its superior and lateral Sides are covered by a kind of Præputium formed by a particular Plica of a Portion of the internal Side of the Alæ, which appears to be glandular, to discharge a Mucus, and is internally granulated.

By Dissection we discover, in the Clitoris, a Trunk, and two Branches, as in the Penis, formed of a spongy Substance, and very elastic Tunics, but without any Urethra: This Substance may be inflated or injected by its Artery. The Trunk is divided into two lateral Parts, by a middle Septum,

from the Bifurcation to the Glans, where it is insensibly lost.

The Bifurcation of the Trunk is on the Margin of the cartilaginous Curvature of the *Ossa Pubis*; and the Branches, which resemble the Roots of the *Corpora Cavernosa*, are inserted into the inferior Rami of these Bones, and into those of the *Ossa Ischium*, where they terminate by Degrees; but there is sometimes a membranous Tube on each Side, which reaches to the Tuberosity of the *Ischium*.

The Trunk of the Clitoris is sustained by a Ligamentum Suspensorium fixed in the Symphysis of the *Ossa Pubis*, and sustaining this Trunk, in its Duplication, nearly as in Man.

Four Muscles, or Fasciculi, of fleshy Fibres are inserted in the Trunk of the Clitoris, two on each Side. One of them runs down on the anterior Side of the adjacent *Corpus Cavernosum*, and is inserted, by a tendinous or aponeurotic Membrane, partly into the Extremity of the *Corpus Cavernosum*, and partly into the Tuberosity of the *Ischium*. These two Muscles are called *Erectores*; but the Name of *Ischio-Cavernosi* would be most proper, as in Man.

The other Muscle on each Side lies under the former, and runs down laterally to the Urethra and great Orifice of the Uterus, all the way to the Anus; increasing gradually in Breadth in its Passage, and terminating partly like that which is called *Accelerator* in Males.

These two Muscles surround, very closely, the lateral Parts of the Urethra and the Entrance of the Vagina. They expand very much as they descend, and are spread on the inferior and lateral Parts of the great Orifice; for which Reason, several Anatomists have looked upon them as muscular

cular Sphincters. All these four Muscles, especially the two latter, are oftentimes almost covered with Fat.

The sanguiferous Vessels of the Clitoris come chiefly from the Hypogastricæ, and the Nerves from the second and third Pairs of the Nervi Sacri, by means of which they communicate with the inferior mesenteric Plexus, and with the great Sympathetici.

The Nymphæ, Cristæ Clitoridis, or, as they may likewise be called, Alæ Minores sive Internæ, are two prominent Plicæ of the internal Skin of the great or external Alæ, reaching from the Præputium of the Clitoris to the two Sides of the great Orifice of the Uterus. They begin very narrow; and, having increased in Breadth in their Course inferiorly, they are again contracted at their Extremity.

They are of a spongy Substance, intermixed with Glands, several of which may be perceived by the naked Eye: Their Situation is oblique, their superior Extremities lying near each other, and the inferior at a much greater Distance. In married Women they are more or less flaccid and decayed.

By the Urethra, in Females, we mean the urinary Duct, the Orifice of which is between the Nymphæ below the Gland of the Clitoris. The Sides of this Orifice are a little prominent, wrinkled, and perforated by small Lacunæ, from which a viscid or mucilaginous Liquor may be squeezed. In Time of Pregnancy this Orifice is sometimes drawn a little internally.

The Substance of the Urethra is a spongy Duct of the same Structure as in Males, but much shorter, situated directly under the Trunk of the Clitoris, and above the great Canal of the Uterus, adhering to each of these Canals, between which it lies, by

membranous Filaments. It passes under the cartilaginous Curvature of the *Ossa Pubis*, and terminates, by an oblique Opening, at the *Cervix* of the *Bladder*; being bent a little inferiorly between its two Extremities.

The internal Membrane of the *Urethra* is a little plaited, and perforated by small *Foramina*, which communicate with *Folliculi*, lying hid in its Substance, as in Males. If we blow into one of these *Foramina*, we observe a small *Duct* inflated, which runs from the exterior to the internal Parts, and terminates, in some Places, by a kind of *Sacculus*, on compressing which, a viscid *Liquor* is discharged.

The Continuation of this Membrane, which lines the *Cervix* of the *Bladder*, forms likewise several *Rugæ*, more or less equal; but that which lines the Cavity of the *Bladder* is wrinkled in an irregular Manner when the *Bladder* is empty.

The great Canal, formerly called the *Cervix* of the *Uterus*, is situated below the *Urethra*, and above the Extremity of the *Intestinum Rectum* a little obliquely; being more raised on the internal and posterior Part than on the external or anterior.

Its internal or posterior Extremity joins that of the Body of the *Uterus*, and surrounds its Orifice much in the same Manner as the *Duodenum* does the *Pylorus*, or as the *Ilium* is surrounded by the *Cæcum* and *Colon*.

The anterior Extremity forms the great Orifice which lies under that of the *Urethra*, and above the *Fossula* of the inferior *Commis sure* of the *Alæ*.

The Body of the Canal is chiefly formed of a spongy Substance interwoven with numerous sanguineous Vessels; and it is commonly longer and narrower in *Virgins*, than in others.

Its

Its internal or concave Surface has several transverse Rugæ, and is covered by a particular Membrane. These Rugæ are formed by oblong narrow Eminences, incurvated like Portions of Arches, placed very near each other, and disposed in such a Manner, as to divide the Cavity of the Canal into a superior and inferior Side.

By the Union of the Extremities of the superior and inferior Rugæ, a kind of Raphe or Suture is formed on the right and left Sides; and both Arches are sometimes intersected in the Middle, and so form two Semicurvatures; but in this there is some Variety.

In general these Curvatures are very considerable in young Persons; become gradually more superficial in married Women, and are quite lost in Time of Delivery.

The internal or posterior Extremity of this great Canal surrounds the Orifice of the Uterus a little obliquely, in such a Manner, that the superior Side of the Canal lies very near the Orifice, and the inferior at a greater Distance from it; and this makes the Extremity of the Uterus appear to advance more into the Canal on the inferior than on the superior Part.

The external or anterior Extremity of this Canal in Virgins, and especially before the first Eruption of the Menfes, is commonly bordered by a circular membranous Plica, of different Breadth, more or less smooth, and sometimes semilunar, which, in some Subjects, leaves but a very small Aperture, in others a larger, and in all renders the external Orifice narrower than the rest of the Cavity. This Plica, called Hymen, is formed by the Union of the internal Membrane of the Vagina with that on the internal Side of the Alæ, and represents a membranous Circle of different Breadth, and sometimes uneven.

This membranous Circle is commonly ruptured after Coition, and is quite lost in Delivery; and afterwards only some irregular Portions of it remain, which, from their supposed Resemblance to Myrtle Leaves, have been called *Carunculæ Myrtiformes*. This Circle may likewise suffer by too great a Flux of the Menfes, or, being thin, may be easily lacerated, by Lasciviousness and other Accidents.

Each Side of the anterior Portion of the Vagina is covered exteriorly by a thin, broad, cavernous, and vascular Plexus, called the *Retiformis* of that Canal: These two *Lamellæ* run down on each Side of the Clitoris behind the *Nymphæ*, and likewise cover the Urethra, like a Collar, before they are spread on the great Canal.

This Plexus is closely united to the muscular Portions commonly taken for Accelerators or Contractors, lying between these Portions and the lateral Parts of the Urethra and the great Canal.

It may be inflated like a flaccid Spleen, or like the spongy Substance of the Clitoris, with which it seems to have some Communication; and, on that Account, the lateral Portions of this reticular Plexus have been named the internal *Crura* of the Clitoris. It is a kind of *Rete Mirabile*, composed of Vessels which arise chiefly from the *Hypogastricæ*.

It still remains to be observed, that, on each Side of the Bottom of the Pelvis, in both Sexes, opposite to the inferior Part of the Bladder, there is an aponeurotic or tendinous Ligament, which runs over the internal Surface of the *Musculus Obturator Internus* from the anterior to the posterior Part. The anterior Extremity of this Ligament is fixed on one Side of the middle Portion of the Symphysis of the *Ossa Pubis*, and the posterior

sterior to the middle Part of the Ligamentum Sacro-Sciaticum.

A little above the Elongation called the *Cervix* of the Bladder, there is another ligamentary Expansion on each Side, the anterior Part of which is narrow, and fixed to the anterior Extremity of the Ligament already mentioned; and the broad posterior Part to the Side of the Bladder: These two lateral Expansions may be looked upon as proper Ligaments of the Bladder, by which it is connected to the internal Side of both *Ossa Pubis*.

To the anterior Portion of each of these Ligaments is fixed a particular Fasciculus of fleshy Fibres, which ascend obliquely on the anterior Part of the Bladder, on which those of each Side meeting, form a kind of muscular Intertexture, and unite with the most transverse Fibres of the Bladder.

These two muscular Fasciculi form a Part, and perhaps a principal one, of what is called the Sphincter of the Bladder; but, to have a true Idea of them, they must be examined in Situ, without destroying any of their natural Connections. When the Bladder is removed out of its Place, as is done in the common Method of Dissection, these Fasciculi are cut; and thereby, their Direction being changed, they appear transverse, and are taken, by those who know no better, for Portions of an orbicular Sphincter.

In Males these two Fasciculi are partly fixed in the Prostates; but in Females they are very broad, and appear sometimes to be double on each Side, one Lamina lying above the other. They are to be looked upon as true Muscles, fixed by small Tendons on the Sides of the Symphysis of the *Ossa Pubis*.

The UTERUS lies between the Bladder and Intestinum Rectum. It is a Body internally concave, externally of a whitish Colour, of a pretty solid Consistence, and, except in Time of Pregnancy, its Figure is that of a flat Flask; being, in Adults, about three Fingers Breadth in Length, one in Thickness, and two in Breadth, at one End, and scarcely one at the other. This Size varies according to the Age of the Subject, &c.

The broadest Portion is named the Fundus, and the narrowest the Cervix. Its Situation is oblique; the Fundus being turned posteriorly and superiorly, and its Cervix anteriorly and inferiorly: The broad Sides lie next to the Rectum and Bladder, and the narrow ones are lateral.

The Cavity of the Uterus is flat, and resembles an oblong Triangle, the shortest Side of which answers exactly to the Fundus, and the two longest Sides lie one on the right, the other on the left; and they are all bent internally, or towards the Cavity formed by them.

Of the three Angles of this Cavity, the two which terminate in the Fundus are perforated each by a narrow Duct, which with Difficulty admits a Hog's Bristle; the third Angle forms a flat Duct wider than the former, which perforates the Cervix of the Uterus longitudinally, and terminates at its Extremity by a transverse Opening.

This Opening is named the internal Orifice of the Uterus; and, in its natural State, is narrower than the Duct of the Collum Uteri, so that only a small Stilet can be admitted. At the Margin of this Orifice are several small Apertures, answering to the same Number of glandular Corpuscles, which discharge a viscid Lympha.

The internal Surface of the Cavity of the Uterus is lined with a very fine Membrane, which at the
Fundus

Fundus is smooth and even, but in the Cervix is wrinkled in a particular Manner.

The Portion of this Membrane, which covers the Fundus of the Cavity, is perforated by a great Number of considerable Foramina, through which small Drops of Blood may be observed to pass, when the whole Uterus is compressed; and sometimes it appears to have very small Villi, or Hairs. Both these Villi and Foramina are observed to be more or less tinged with Blood, in those Women who die in the Time of their Menfes.

In the narrow Part, which answers to the Col-um, each Side is divided into two Laterals by a kind of prominent longitudinal Line, which is larger in the superior or anterior Side, than in the inferior or posterior.

On each Side of these two longitudinal Lines, there are others, or Rugæ, obliquely transverse, disposed like longitudinal Branches representing Trunks; between and round these Rugæ there are small Lacunæ, through which a mucilaginous Fluid is discharged, which it is said in Pregnancy lutes the internal Orifice of the Uterus (which seems inconsistent; as the Cervix is a true Sphincter to the Fundus: For as the Uterus dilates, the circular Fibres of the external Orifice of the Cervix contract, till they are all extended, which is generally about the Time of Delivery; and I think every Practitioner in Midwifery must be sensible of the Truth of what I here advance). We observe likewise, in the Interstices between the Rugæ, several transparent globular Corpuscles, which a modern Author took for a kind of Ova.

The Substance of the Uterus is spongy and compact, with a copious Intertexture of Vessels: Its Thickness is nearly equal and uniform in the Sides and Margins, but the Fundus is thicker towards the Middle than the two Angles, where the Thick-
ness

ness decreases gradually. The Margins are likewise much thinner near these Angles, than the Extremity of the Cervix.

The Uterus is covered by a Portion of the Peritonæum, which serves as a Tegument, and is a Continuation of that which covers the Bladder and Intestinum Rectum; running up from the inferior and posterior Part of the Bladder over the anterior Part of the Uterus, thence over the Fundus, and down the posterior Side, and afterwards going to the Rectum.

On each lateral Part or Margin of the Uterus this Portion of the Peritonæum forms a broad Duplicature, which is extended on each Side more or less, directly to the contiguous lateral Parts of the Pelvis, forming a kind of membranous Septum between the anterior and posterior Halves of that Cavity; and is afterwards continued loosely, with the Peritonæum, on the Sides of the Pelvis.

These two broad Duplicatures have the Name of Ligamenta Lata, and Vesperilionum Alæ. The superior Margin of each is partly double, or folded, forming two small distinct Duplicatures, which WINSLOW calls the Pinions of the broad Ligaments. The anterior Pinion is more raised than the posterior, and they are both very loose.

The Laminæ of all these Duplicatures are connected by a cellular Substance, in the same Manner as the other Duplicatures of the Peritonæum; and they contain the Fallopian Tubes, Ovaria, Part of the spermatic Vessels and of those which go to the Body of the Uterus, the Ropes * called the round Ligaments, Nerves, &c.

* Hence chiefly come those Pains and Numbness which pregnant Women complain so much of in those Parts, and which increase as the Uterus grows bigger and higher.

The Antients imagined that the Ligamenta Rotunda were two hollow Tubes, whereby Women emit their Semen: But as these Ligaments have not yet been demonstrated to be tubular, this Argument cannot take place. The Moderns say, they suspend the Uterus, and hinder its rising too high: How, then, can pregnant Women suffer it to ascend sometimes even into the Epigastrium? Neither are they sufficient to keep the Matrix from rolling, in convulsive Motions. In hysteric Affections the Uterus moves sometimes upwards, sometimes downwards, with so much Force and Violence, as shews that these Ligaments have but little Power over it.

From what has been said it appears, that both the Antients and Moderns understood not the true Use of these Ligaments.

However, their Actions conjointly with the Ligamenta Lata, seem to be rather intended by Nature to keep the Uterus in a proper Situation, during the Time of Pregnancy, than for any other Purpose.

They hinder the Body of the Matrix from pressing too much on its Cervix, and subsiding, or bearing down, as happens when these Ligaments are too much relaxed by difficult Births, &c. It is from these Duplicatures that Women with Child feel Pains and Lassitude in the Loins.

The Uterus is said to be oblique when it inclines either posteriorly or anteriorly to the right or left Side; that the Os Uteri, being distorted in such a Manner from its natural Direction, towards any Bone of the Pelvis, can scarcely, or not at all, be touched; and this is termed a preternatural Position or oblique Situation of the Womb; and which may happen either before or in Time of Pregnancy.

The Obliquity of the Uterus may be occasioned by many and different Causes, whereof some are

transitory, others permanent: Such are Spasms, inflammatory Tumors, Dropsies, Hydatides, Ulcers, an indurate Gland, a fungous Excrescence, Cicatrix, or the like; either in the Uterus, Ligaments, or adjacent Parts: Also the Weight and Bulk of its Fundus, and over-extended Ligaments in Time of Pregnancy; for we see how variously Women with Child move their Bodies, bending them every way for Relief, when afflicted with Pain; both sitting and lying in different Postures; all which may easily give the Womb a Tendency this or that Way: Likewise a Strain, or Rupture, in any of these Ligaments, from violent Efforts, so that its Antagonist acts too forcibly. And, lastly, from any irregular Conformation either of the Uterus, Ligaments, or Bones of the Pelvis. Hence the Obliquity of the Uterus sometimes happens in Virgins.

It commonly hinders Conception; and, if it happens at the Time of Pregnancy, occasions difficult and dangerous Labours.

The OVARIA are two whitish, oval, flat, oblong Bodies, situated on the Sides of the Fundus Uteri, to which they are fixed by a kind of short round Ligament, and inclosed, together with it, in the Duplicature of the posterior Pinion of the Ligamenta Lata.

They are composed of a compact spongy Substance, of several little transparent Vesiculæ, which are called Ova. The spongy Substance surrounds each of these Vesiculæ very closely, and seems likewise to furnish them with distinct spongy Calices. They are to be carefully distinguished from other preternatural ones termed Hydatides.

The Ligaments of the Ovaria lie in the Margins of the posterior Pinions of the Ligamenta Lata, much in the same Manner as the umbilical Vein in the anterior or umbilical Ligament of the Liver.

Liver. They are round Ropes, of a filamentary Texture, fixed by one Extremity to the Corner of the Fundus Uteri, a little above and behind the Level of that Fundus. They were formerly believed to be concave, and looked upon as Vasa Deferentia.

The FALLOPIAN TUBES are two flaccid, conical, and vermiform Canals, situated more or less transversely on each Side of the Uterus, between the Fundus and the lateral Parts of the Pelvis, and included in the anterior Duplicatures or Pinions of the Ligamenta Lata.

Each of them is fixed, by its narrow Extremities, in the Corner of the Fundus Uteri, into which it opens, though by so narrow a Duct as hardly to admit a large Bristle: From thence their Diameter augments, by degrees, all the way to the other Extremity, where it is about one third Part of an Inch. The Body of the Tubæ goes on in a winding Course, and their large Extremity is bent towards the Ovaria.

These large Extremities are irregularly round, and terminate by a narrow Orifice, a little plaited and turned towards the Ovarium, where it presently expands in Form of a membranous Fringe, full of Plaits and Incisures. These Fringes are called the broad Ends of the Fallopian Tubes.

The Breadth of the Fringe is not equal in all Parts. Its Circumference is in a manner oval, and its longest Segment reaches to, and is fixed in, the Ovarium. The Plicæ are disposed, like Laminæ, on the concave Side.

These Tubes are composed of fleshy Fibres, some of which are longitudinal, and others obliquely circular, with an Intertexture of another very fine Substance.

The anterior Pinions of the Ligamentum Latum serve for a common or external Tunic to both Tubæ,

Tubæ, and also to connect them, in the same Manner as the Mesentery connects the Intestines; from thence the Tubæ, and especially their Fringes, come to be loose, and their Direction very imperfectly determined in most Figures.

Their Cavity is lined with a soft glandular Membrane, which is plaited longitudinally, almost like the internal Surface of the Aspera Arteria; and these Folds are stronger and broader near the great Extremities than any-where else. Their Substance seems to be spongy, and the Interstices between them are moistened, more or less, by a Fluid which is continually discharged there.

The sanguiferous Vessels of these Parts are of different Kinds; viz. the hypogastric Arteries and Veins, the Ramifications of which belong chiefly to the Body of the Uterus; the spermatic Vessels, and the two Ligamenta Rotunda.

The hypogastric Branches are arterial and venal Ramifications arising from the Artery and Vein of the same Name, which, having reached the lateral Margins of the Uterus, are distributed to all the Parts thereof, both internal and external, forming a great Number of Incurvations and particular Intertextures.

The Arteries of one Side communicate both upon the Uterus, and through its whole Substance, with those of the other Side, and the arterial Ramifications of each Side form numerous Anastomoses with each other. The Veins communicate together, on each Side, in the same Manner; and all these sanguineous Vessels communicate likewise with the spermatic Vessels, Ligamenta Lata, and Hæmorrhoidales.

These frequent Anastomoses may be demonstrated by injecting, or blowing into, the hypogastric Vessels, having first made proper Ligatures, to prevent the Liquor or Air from running
into

into other Parts. The Extremities of these Arteries terminate and open into the Cavity of the Uterus; and there is this peculiar to the Veins, that they communicate with the Hæmorrhoidales, and consequently with the Venæ Portæ.

The spermatic Vessels have nearly the same Origin in Females as Males, and likewise the same Course and Intertextures; but they never pass out of the Abdomen, being wholly distributed to the Ovaria and Tubes, and communicate with the Hypogastrics and Ligamenta Lata. The Veins are very large in proportion to the Arteries, and these Vessels send lateral Ramifications, which seem to communicate with the Mesaraicæ and Venæ Portæ.

The Ligamenta Rotunda are two long small Fasciculi of Arteries and Veins, interwoven and connected by a fine cellular Substance, and run in the great Duplicature of the Ligamenta Lata from each Corner of the Fundus Uteri, as far as the annular Openings of the abdominal Muscles.

In this Course each Ligament thrusts externally, or raises the anterior Lamina of the Duplicature, which, consequently, gives a kind of Tunic to these vascular Fasciculi, and makes them appear like distinct Ropes connected to this anterior Side of the Duplicatures.

They seem to arise from the Communication between the Vasa Spermatica and Hypogastrica, and might be reckoned a particular Continuation of the spermatic Vessels. The Disposition of their Adhesions to the Angles of the Fundus Uteri, with respect to that of the Tubes and Ligaments of the Ovaria which lie all near each other, is thus: The Tubes lie superiorly, the Ligaments of the Ovaria posteriorly, and the Ligamenta Rotunda anteriorly, and a little lower than the former.

Afterwards they run in a Course nearly resembling that of the spermatic Vessels in Males, pass the Abdomen through the Openings of the abdominal Muscles, and are lost in the Fat of the superior and middle Parts of the Groins. (It may be conjectured, that these Ligaments or Vessels furnish the *Lacunæ*, of which hereafter.) As they pass out of the Abdomen, they are accompanied by a Production of the cellular Portion of the *Peritonæum*, as the spermatic Vessels in Males, and by a *Fasciculus* of fleshy Fibres, representing a kind of *Cremaster*.

Besides all the Vessels hitherto mentioned, we observe Nerves and Lymphatics, to which we may add the lactiferous Ducts which are seen in an advanced Pregnancy. The Nerves come from the *Lumbares*, *Sacri*, and *Sympathetici Maximi*, the same as in Males. The Lymphatic Vessels run chiefly in the Tunics continued from the *Peritonæum*, and also the particular Fibres which seem to be interwoven in the Substance of a pregnant Uterus; the interior of which being disposed in a vortical or turbinated Manner, gave Occasion to *RUYSCH* to describe them particularly by the Name of *Musculus Uteri Orbicularis*.

All the lymphatic Veins of this Organ terminate in a large Gland, situated in the Division of the iliac Vessels. The Vessels of the Pelvis are larger in Women than in Men.

ASTRUC remarks, on the Tunics or Membranes of the Uterus; that the first is the *Peritonæum*; the second, or middle Tunic, is muscular, composed of Fibres almost in *omnem sensum* like a Bottom of Thread: For saying that these Fibres are longitudinal, circular, and oblique, gives not a sufficient Idea of their Direction. Yet I own, that the greater Part of these carnous Fibres are
longi-

longitudinal; Nature foreseeing their greater Use in the Function of this Organ, particularly for Copulation and Gestation. The third, or internal Tunic, is nervous, and thicker than the external one. It is full of Asperities on its convex Surface, for the closer Adhesion to the superior Membrane; but smoother on the concave one, that it may the better expel the Menfes, and retain the Semen Virile. These Eminences are named Glands by some, but I call them Colatoria Lactea, or vesicular Substances. That there are such vesicular Substances*, with a great Number of other Vessels, is evidently proved by Experiments: For if you sufficiently macerate a Uterus, and then press a Portion of it, you will observe the gaping Orifices of these Vessels eject their Contents.

That these Colatoria are simply vesicular in Sheep, and vascular, or only composed of Vessels, in Swine; but in Women they are vesiculo-vascular, or composed of small Bladders and lacteal cylindric Vessels, at the same Time; the excretory Ducts of them gape into the internal or concave Surface of the Uterus. In these Vasculars is secreted a lymphatic Matter, whilst the Subject is young; but when she comes to have her Menfes, and her Breasts swell (or, as they say, fore Breasts), the Matter is chylous, or milky. In Pregnancy it is still more so; but at the Time of Parturition it is pure Milk, as we observe in the Breasts, and that in the same Proportion and Degree: Nay, the Glands of the Uterus, by Analogy, may be compared to those of the Breasts; the former being the Vicegerent of the latter. For the Glands of the Matrix nourishes the Fœtus

* This secreted Liquor is very profuse in Female Infants, but afterwards gradually diminishes.

with their excretory Liquors, as the Breasts afterwards do the Infant with Milk.

With regard to the Distribution of the Veins, with their particular Texture in the Uterus; the uterine cylindrical Arteries still preserve this Figure, particularly at their Extremities, till, by the Accession of other capillary Vessels, their Diameters are gradually enlarged; at which Time they acquire a conic Form, and get the Name of Veins; still, by their Union and Reunion, forming larger Trunks, which are of considerable Diameters in the Uterus, in which Organ they form numerous Angles, Contortions, and Anastomoses, the Reasons whereof shall be given hereafter. Besides these, there is another remarkable Singularity observable in these Veins; viz. each Vein is divided, at its Extremity, into two Branches; one to entertain the Circulation, the other, like the Cæcum Intestinum, as a kind of Appendix to receive the menstrual Blood. These venous Appendices, especially at the Time of Conception, become so turgid, by the Quantity of Blood they receive, that they acquire a considerable Length, and are pendulous on the internal Surface of the Matrix. Besides the Assistance these Vessels lend, in the Explication of the Menfes, they contribute, also, to unite the Placenta (into which they are inserted) to the Uterus. That there are such Appendices, is proved, 1. By mercurial Injections, which pass, by these Vessels, into the Uterus. 2. Because no Births happen without a plentiful Discharge of Blood, which is attributed to the Dilaceration of some of them by the Division of the Placenta, into which they are inserted. 3. These are visible, to the naked Eye, in Women who die in Child-birth, in whom they are very prominent.

The Structure of the Vagina needs no particular Explication, being so like that of the Uterus.

We

We now see, that the Substance of the Uterus is singularly composed of innumerable Vessels, and membranous and muscular Parts; which, being all most curiously interwoven, are admirably formed together in its Texture, that it might be the more capable (without Danger of breaking) to suffer the Extension which the Child and Waters cause during Gestation; to contract in Time of Labour; facilitate the Expulsion of the Fœtus and Placenta, and retract again to its natural Dimensions.

The Use of the Womb is, for the Procreation of our Species; and the Blood, which is collected in the Sinuses, is usually discharged every Month, which is called the Menfes, when Women are in a healthy State, and not pregnant; as also to retain the Semen Virile, nourish the Fœtus, and preserve it till the Time of Birth.

OBSERVATIONS.

The Clitoris, in some Females, is so long and large, as to have been taken for a Man's Penis unperforated; whence, probably, those Females have been called, and believed to be, Hermaphrodites: But I cannot think that there is any such Thing, in the whole *Lufus Naturæ*, as one who has the perfect generative Parts of Male and Female.

Professor DIEMERBROECK relates, that a Woman applied to him having a diseased Clitoris. She told him, that in her Youth she contracted a Custom of stimulating her Clitoris with her Finger, so as to excite Emissions, which gave her a great deal of Pleasure. Vid. *Anatom. Corp. Human.*

It is reported, that the Women of Asia cause their Clitorises to be burned by old Women, who make it their Practice. The Egyptians cut it before their Daughters are married.

BELLONIUS and PAULUS JOVE thought, that the Ethiopians circumcised the Clitoris.

AETIUS and EGINETTUS direct how to perform that Operation in the eastern Countries, and perhaps at the Example of the Tribade Bassa; which occasioned MARTIAL to write these Lines:

Commenta est dignum Thebano Ænigmate
monstrum,

Hic ubi Vir non est ut sit adulterium,
Inter se geminos audet committere cunnos
Mentiturque virum prodigiosa Venus.

But CICERO, Lib. I. De Divinatione,

——— Quid cum cumis APOLLO sudavit,
Capuæ victoria! Quid ortus Androgyni!
Non fatale quoddam monstrum fuit!

seems to think, that the Opinion of Hermaphrodites may perhaps have took its Rise from Jewish Rabbi's. And most of the antient Hebrews were of Opinion, that ADAM was first made an Androgynus, commonly called Hermaphrodite; and that he had the Parts of both Male and Female; and that these Parts were afterwards separated: The back Part was named EVE, &c. This was occasioned by endeavouring to explain that Text of the Old Testament; "Male and Female created he them*.—Thou hast formed me behind and before." Or "God created Man Male and Female," &c. Hence it is no Wonder, that this Opinion of Hermaphrodites has been so universally believed, and Laws made against them. Vid. HEIDEG. Histor. Patriarch. & Jus.

* ויאמר אלהים נעשה אדם בעלמנו כדמותנו וירדו כדגת הים
ובעוף השמים ובבהמה ובכל הארץ, ובכל ח' מוש' הרמוש על
הארץ: ויברא אלהים את האדם בעלמנו בעלם אלהים ברא
אתו זכר ונקבה ברא אתם. Gen. i. 26, 27.

According to this Way of explaining the Scripture, they make God to be an Androgynus; as in the Beginning of the 26th Verse of the first Chapter of Genesis.

The Existence of the Hymen has been much disputed by anatomical Authors, since it has been described; some denying that there is such a Membrane: But there are many who, though they will not deny that Authors of Veracity have found this Membrane in the Entrance of the Vagina; yet say that it is a preternatural one, and not to be met with in very young Subjects, notwithstanding they had neither been concerned with Man, or otherwise destroyed.

Indeed in lieu of the Hymen, or Carunales, sometimes we find there a Membrane which closes the Aperture of the Vagina; but this Membrane is preternatural: We are obliged to divide it sometimes, but very rarely.

A Girl was pronounced pregnant by the Midwives, on account of an Inflation and Tension of her Uterus, occasioned by a considerable Quantity of menstrual Blood retained by a similar Membrane: But when an Incision was made, the retained Blood was discharged. Vid. AMBROSE PARE, Lib. xxiv.

Mr. BOUDON, senior Surgeon to the Hôtel Dieu of Paris, met with the like Membrane in a young Lady who was thought to have a Schirrus of the Uterus; for which supposed Disease she had been a long Time under Cure; and, when well examined, was cured by an Incision in the Membrane which obstructed the Discharge of her Menfes. We read the like in SAVIARD's 1vth Observation.

RUYSCH mentions a Woman, the Membrane of whose Hymen was intire, and very thick, which was thrust out by the Head of the Foetus. She

had been in Labour a long Time, and could not be delivered without dividing this Membrane by Incision. But we met with another behind it, which more deeply closed up the Passage of the Vagina, and obstructed the Exclusion of the Fœtus; wherefore he was obliged to open this Membrane also. After this last Operation, the Woman was delivered of a fine Child alive, and both did very well afterwards. Vid. Obs. xxii.

So, according to RUYSCH's Account, that Woman had two Hymens.

The Hymen, so called, appears to me to be only a Continuation of the internal Membrane of the inferior Part of the Vagina with the external one; and what are named Caruncles, or Myrtiformes, are inclosed in these Membranes. For I suspect the Caruncula not to be a Fragment of the Laceration of the Hymen (as it is commonly thought); but am apt to think they are Glands.

It does not always grow so high as the Semidiameter of the Vagina: Therefore in Women who have these Parts pretty large, they are not discernable.

In that Case of RUYSCH, here inserted, those Membranes of the Vagina certainly grew up after the Woman was impregnated, and her Husband had but a small Penis, which, when it meets with a large Vagina, may be admitted without lacerating the Hymen, especially if the Membrane is pretty strong, or low.

I have met with such small Penes, that, I dare say, they might copulate with most young Virgins without lacerating their Hymens; and I have seen the reverse in the Vaginæ of some Women, which have been smaller after Child-bearing than before, that is, more contracted.

SAVIARD gives an Account of a Woman in whom he found the left Testicle as big as a Child's Head,

Head, which he first took for a Foetus invested in its Membrane; but this vast Volume was a Mass of pulposus Matter hardened, with a Mixture of Serosities; the whole weighing four Pounds.

In another Woman he found also one of her Testicles about the Bigness of a Hen's Egg. I observed, on opening it, that it was caused by an Obstruction of whitish Matter. Vid. Obs. xcv.

I injected the whole Substance of the Ovary of a Woman, about twenty Years of Age, which I preserved.

Several Ovaries (as the Moderns called them) I found diseased by venereal Infections. They appeared somewhat like the internal Substance of Male Testes.

Dr. SAMSON gives us an Account of a Woman who died of a Dropsy of the left Ovarium. There was no extravasated Water in the abdominal Cavity, but it was filled with a Number of Vesicles, of different Sizes, full of a viscous Serum, some so large as to contain twenty Pounds of this Liquor, others about the Size of a Child's Head, as big as an Orange, and the rest not larger than a Walnut. On examining these Vesicles, he found them to be no other than the Ovula of the left Ovarium distended to that monstrous Size. He says, if you can imagine about forty Bladders, of different Sizes, tied together like a Reeve of Onions, you may have an Idea of this Ovarium. All the Vesicles contained about an Hundred and Twelve Pounds of Serum. Philosophical Transactions, Numb. 140.

We read of a Case somewhat like it in BLANCHARD. The right Ligamentum Lata was very much distended by about a Hundred and Twelve Pounds of clear Water, of a saltish Taste, and Half an Inch thick, having superficially a great many aqueous Vesicles; and in the opposite Side another Tumor,

con-

containing a purulent Matter; and several Vesicles, which weighed, at least, ten Pounds; and a third Tumor, about the Magnitude of two Fists. Vid. 2 Cant. Obs. xcviII.

In a Woman who died of a Dropsy, her left Ovarium was swelled to a prodigious Size, so as to weigh Thirty-seven Pounds; and was divided into a great many Cyfts odly complicated together. Some contained a clear Water, others a gelatinous Liquor, a Fluid like Cream, and others like Tallow. In some Parts it had a glandular, in others a fleshy Appearance. RIDLEY's Obs. Medic.

In another Woman, who died of a Dropsy, her right Ovarium was very near a Foot long, as much broad, and six Inches thick. See Medical Essays, Vol. V. Art. LXXIII.

I once met with the left Testicle of a Male distended to the Bigness of one's Wrist (I do not mean the Scrotum) with Vesicles, as in the above-mentioned Cases, filled with a pellucid Lympha, which communicated with each other. Upon examining these Vesicles, they seemed to be nothing else but a Distension of the lymphatic Vessels.

LITTRE*, in dissecting a Female of two Months old, found her Vagina divided perpendicularly, by a fleshy Partition, into two equal Parts, in such a Manner, however, that the Partition was not intire, but only formed two Cavities from the Middle of the Vagina to the Uterus. Each of these Cavities terminated in a particular Uterus which had its Orifice, Cervix, and Fundus. These Sorts of Uteri, which were distinct and separate internally, had externally but one simple and continued Body, except their Bottoms, which were separated, or rather fixed to each other, only by a

* Vid. Memoires de l'Acad. des Sciences 1705; aliò JOANNES SCHENCK Observ. de Utero, &c.

membranous Ligament of a triangular Figure. There were also an Ovary, Ligaments, Latum, and Rotundum. LITTRE thought, that if this Girl had lived, and conversed with a Man, she might have conceived at different Coitions, and impregnated both Uteri.

RUYSCH says, that he saw a female Child, about six Days old, who had a monstrous Conformation of the Parts of the Pudenda, which was united to the Navel, or rather with that Part of the Body which was in lieu of the Navel, the whole confused, and a Heap of excoriated Tubercles; in the inferior Part of which appeared two Foramina, from whence the Urine continually dropped, especially when the Child cried. Without doubt there was no urinary Bladder, as there was no Meatus Urinarius; and these two Foramina continued to the Ureters.

This Misconformation of Parts might perhaps arise from a Fright which the Mother received on falling from a high Place, several Weeks before her Delivery. Vid. Observ. xxiii.

The same Author relates, that a Woman, after having been a long Time afflicted with the Fluor Albus to an excessive Degree, afterwards had a Prolapsus Uteri, from the internal Orifice of which grew various Excrescencies of a ponderous Substance, partly membranous, and partly fleshy. These Excrescencies were somewhat like the Polypuses: They were very painful to the Woman, and a great Quantity of aqueous acrimonious Humour was discharged daily from the Uterus. At last, the Malignity of these Tumors killed the Patient.

Much the same Polypus Tumors were discharged, at several Times, by another Woman, and sent to me, by the Surgeon who attended her. Obs. vii.

Another

Another Woman had an Ulcer in the Uterus, attended with a continual Bleeding and insupportable Pains, which put an End to her Life. On opening her Body, the Cervix of the Uterus separated from its Body, by only touching it, as if it was intirely putrefied. The Intestines were externally united by a slight Excoriation and Inflammation, but the other Parts were sound. Ibid. Obs. xii.

I have likewise met with several ulcerated and gangrenous Uteruses: Some proceeded from venereal Infection, others from Hurt received, at the Time of Delivery, by unskilful Midwives.

RUYSCH, in his xxvith Observation, mentions a Woman, lately delivered of a large Child, whose Uterus followed the Placenta immediately, and was inverted; whereupon an ignorant Medicafter was called in. This Fellow, instead of replacing the Uterus in its proper Situation, cut a little way into it (as he thought it was a Tumor) with the Point of a Betoury, in order to discover whether it was a preternatural Tumor filled with Matter, or the Placenta Uterina. This rash Proceeding soon killed the Patient; for a profuse * Hæmorrhage immediately ensued, which could not be suppressed by all my Endeavours.

VIEUSSENS mentions a bleaching Woman, aged Thirty Years, of a strong Constitution, who was afflicted with a Prolapsus Uteri, which fell into the Pudendum, in the Figure of a round reddish Tumor, almost as large as two Fists (which was the Uterus). As this supposed Tumor was not reductive, it was extirpated with a Ligature, and the Patient was cured.

* The Cause of this profuse Hæmorrhage was, because the Vessels of the Uterus were not contracted; nor could it be, whilst the Uterus was prolapsed.

Six Years after the Patient died. On opening the Body, there was found only a small Portion of the Cervix of the Uterus cicatrised, which was very hard and callous.

AMBROSE PARE likewise tells us of a Woman, who, after considerable Vomitings, with violent Efforts, felt between her Thighs a great Weight, which was troublesome to her. On examining the Parts, it was found to be a fleshy Substance projected into the Pudendum, which could not be reduced; and as it began to be gangrenous, which determined PARE to extirpate it, in Presence of several Physicians and Surgeons. Examining this Substance after it was amputated, it proved to be the Uterus with one of the Ovaries. Vid. Lib. xxxiv. and the like in JOAN. SCHENCK Observ. Lib. iv. MICHAEL ALBERT. Obs. Med.

A Woman, after many laborious Deliveries, had a Prolapsus Uteri, which could not be reduced, but became gangrenous, and dropped off of itself. Vid. ROUSSETUS De Part. Cæsares.

A SURPRISING NUMBER OF STONES EXTRACTED BY INCISION FROM A WOMAN.

Among all the Disorders which usually afflict human Bodies, the Stone of the Bladder is one of the most grievous. Though this is very frequent with us in Holland, yet it appeared in a very extraordinary and unheard of Manner, in a Woman of Eighty Years old; who was, by reason of the Pain, very much emaciated; and who had been, for the Space of Twenty Years, troubled with a Prolapsus Uteri, accompanied with an intolerable Difficulty and Pain in making Water; insomuch, that the Patient chose much rather to die than any longer suffer this Torture, especially during the two last Years.

At

At length, in the Month of May, Anno 1681, she sent for me, complaining of a Prolapsus Uteri, and Difficulty in making Water. I wondered at her Complaints, because Women are never used to suffer such Pains only from a Prolapsus Uteri: And I added, that it was to be feared, some other Disorder, besides the subsiding of the Uterus, lay, as yet, concealed.

When she heard this, she did not refuse to let me see, and farther examine, the Parts, without which, nothing certain could be affirmed concerning the Nature or Essence of the latent Malady: She likewise shewed me her prolapsed Uterus.

On examining the said Uterus with my Fingers, I thought I felt Stones, as indeed it happened, notwithstanding I was mistaken with respect to the Figure of them; for they seemed to me to be like thin flat Stones, or Pieces of Slate: Whereas after Incision they were found thick and angular. But as yet I could not certainly determine whether the forementioned Stones were seated in the Cavity of the Uterus itself, or whether they were lodged between its Membranes, or in some Part of the Bladder. They seemed indeed to occupy Part of the Uterus, the Whole of which, as far as could be perceived, prolapsed without being accompanied by any Part of the Bladder. Having seen and examined these Particulars, I proposed cutting out the Stones; and Mr. PETER ADRIAN junior, with Mr. ANDREW BOCKELMAN, two very expert Surgeons, were called in. They likewise consented that the Operation should be performed the next Day. When the unfortunate old Woman heard that the Operation was deferred till the next Day, she began to weep, and cry out, O how miserable am I! Will you leave me without Help, or not return speedily, &c. ? By which,
and

and the like Complaints, being moved with Compassion, we instantly performed the Operation by a simple Incision, continued according to the Length of the prolapsed Uterus; and, by that means, we extracted, in the Space of a Minute, Forty-two Stones, partly by Instruments, and partly by the Fingers alone, the Magnitude and Figure of which were various.

During the Operation, the Patient did not complain much of Pain; and after it was performed, by being freed of the oppressive Weight, those excruciating Pains vanished, with which she had been tortured for so many Years past; so that she began to live with tolerable Ease. On making the Incision, a Sort of Liquor flowed from the Wound, together with Drops of Blood, from whence we suspected that the Bladder was also at Hand, as indeed it proved: For the next Day, on making a more diligent Inquiry into this Affair, by injecting a Liquor, with a Syringe, thro' the Meatus Urinarius, we found, that it discharged itself through the Wound; which Liquor distilling, together with the Urine, through the Wound for several Days, made it evident, that the fore-mentioned Stones were lodged in a Portion of the Bladder prolapsed without the Labia, in Company with the Uterus.

The continual Discharge of the Urine this Way, proved a great Obstacle to us in the Cure of the Wound, which yet was completed in a short Time by the following Method.

Some Days after, the Wound had been dressed with Linimentum Arcæi, the Lips thereof were approximated and retained very closely together by Emplastrum Diapalma, to which was added a little Turpentine, to make it stick the more firmly; which Plaster was cut into a convenient Shape, and retained with suitable Compresses, and a Bandage.

But

But as this Method did not sufficiently answer our Expectation, on account of the continual dripping of Urine, and Relaxation of the sticking Plaisters; Mr. BOCKELMAN contrived a leaden Ring instead of the Emplastrum, the crooked Extremities of which Ring were drawn together by a Thread; by which means the Lips of the Wound were so exactly closed, that none of the Urine was any longer discharged; and thus the Wound was agglutinated in the Space of three Days.

In this Disorder there are several Things which ought to be remarked, and which are even surprising: Such as,

1. That the prolapsing Uterus should take with it so large a Part of the Bladder, which is certainly a Thing very rarely, if ever, observed before, notwithstanding these two Bodies; or Viscera, are continuous together near the Os Tincæ. But I believe this to have happened, in the present old Woman, by reason of the Difficulty in her making Water, proceeding from the great Number of Stones; whence she was obliged to strain violently to discharge the Urine; by which Force, and the forementioned Cohesion of the Bladder, it could not be hindered from descending.

2. It is remarkable, that the prolapsing Tumor resembled nothing but the Uterus, receiving no Inequality, nor Change in Figure, either from the Magnitude or Number of the Stones: For the Surface of the Tumor was extremely equal, the Uterus retaining its natural Figure.

3. It is surprising, that all the Stones should be nearly of the same Figure; having their Surfaces as smooth as if they had been polished.

4. That the Wound was very readily brought to heal, though it was inflicted upon the membranous

branous Part of the Bladder, into which the Urine is continually distilling.

5. It is to be observed, that all the Stones were not lodged in that Part of the Bladder, which, investing the Uterus above, was prolapsed, together with the same, out of the Body: For the prolapsed Part of the Bladder was not large enough in Proportion to the Magnitude and Number of the Stones; some of which, doubtless, descended, in the Operation, from the Fundus of the Bladder above.

6. That it is a Thing almost unknown, or scarce heard of, for Lithotomy to be performed, with so much Success, on a Woman so far advanced in Years. We often, indeed, hear of Stones extracted from Women by dilating the Urethra; but it is very rare that an Incision is made through the Bladder, to extract the Stone contained therein.
FRED. RUYSCH's Obs.





LECTURE XV.

Of the CATAMENIA, or MENSES.

THE Descriptions we have hitherto given, are common to all Ages of Females; but about the thirteenth or fourteenth Year, nearly at the same Time when the Semen begins to form itself in Males, there are likewise considerable Changes produced in Females: For, at this Time, the whole Mass of Blood begins to circulate, in a Girl, with an increased Force; the Breasts are filled up, the Pubes begin to be cloathed, and at the same Time the Menses, in some measure, make their Appearance. But before the menstrual Flux, there are various Symptoms excited in the Loins; heavy Pains, Headachs, and cutaneous Pustules, commonly succeed. For now the Flux of the uterine Vessels, which, in a Fœtus State, transfused a sort of lacteal Matter, and afterwards a serous Liquor, now begin to swell with Blood; which is distributed, in these Vessels, into the Cavity of the Uterus. This continues for some Days, whilst, in the mean Time, the first troublesome Symptoms abate, and the uterine Vessels, gradually contracting their Orifices, again distil only a little serous Moisture, as before. But the same Efforts return again, at uncertain Intervals, in tender Virgins; till at length, by Degrees, they continue near to the

the End of the fourth Week ; at which Time follows a Flux of Blood, as before, which is periodically continued till between forty and fifty Years ; though the Diet, Country, and Constitution, cause a great Variation in this Respect.

This Discharge of Blood, from the Vessels of the Uterus itself, is demonstrated, by Inspection, in Women who died when they had their Menfes ; and in living Women, who have an Inversion of the Uterus, the Blood has been seen plainly to distil from the Orifices of the uterine Vessels.

As to the Quantity of Blood evacuated at every Period of this Flux ; the most I know is, that, in healthy Women, it is rarely less than eight Ounces, or more than twelve ; but even this is variable, according to the Constitution, Age, Diet, Climate, Season, Exercise, &c. For some Women discharge but four or five Ounces of Blood, whilst others lose twenty or thirty Ounces, as is observed in plethoric Women.

If a Woman has but little Evacuation, as when advanced in Years, she becomes barren ; inasmuch as this Blood is required to nourish the Fœtus ; and if it be too profuse, the uterine Vessels become thereby too lax ; that is, they lose their Elasticity : Therefore the Matrix, in this State, is unable to conceive.

The Duration of the Menfes is very uncertain. In some Women it lasts three, four, or five Days only ; nay, but twenty-four Hours ; yet in others this Evacuation continues for seven or eight Days. The most usual and natural Duration is, between three and five Days ; and that flowing by Degrees, without Intermiſſion, and not all at once ; for great and sudden Evacuations cause a great Dissipation of the Spirits.

Another Variety observable in the Course of this Flux is, that some Women have it more abundantly in the Night-time, by means of the Heat of the Bed, and the Rarefaction of the Blood; whilst others are subject to a more copious Evacuation in the Day-time: All which chiefly depends on the Spissitude or Tenuity of the Blood, and the Relaxation of the Orifices of the uterine Vessels.

If the Moon has any Influence on this Discharge, as several eminent Authors have advanced, I think all Women in the same Climate, and of the same Age and Constitution, would have their Menfes at the same Time and Season; but it is quite otherwise.

The Antients imagined the Menfes to be so venomous and malignant, as to be ranked among Poisons. That they withered Flowers, marred Liquors, tarnished Looking-glasses, with several other surprising Effects affirmed by them. But the repeated Experiments of the Moderns, on this Subject, have convinced us of the contrary of that Opinion; it being found that the menstrual Blood, in healthy Women, has no ill Quality in its own Nature, but is as good as any of the whole Mass, if not tainted and corrupted by its long Continuance in the Sinuses of the Uterus, or by its Heat, or Mixture with some infected Lympha.

Sometimes the Menfes are more like Serum than Blood; which is oftener the Case in young Women than those advanced in Years.

Most Authors agree, that the menstrual Blood is discharged from Veins (or, more properly speaking, from the uterine Sinuses), as its Stillicidium seems to argue; also on account of its dark Colour, which is not so in the arterial Blood.

The Structure of the Uterus evinces, that this Blood is discharged by the same Vessels; viz. the venous Appendices which convey the Humours

to the Placenta; but Reason and Experiments demonstrate that these are Veins. The Effusion of Blood, in Menstruation, is not caused by the Rupture of those venous Appendices, or *Venæ Cæcæ*; but rather by the Extension of their Extremities: Nor are they lacerated; but we may safely conclude that they have natural Apertures.

These Apertures are not procured in the cylindric Extremities of the Arteries; for these degenerate into their corresponding Veins: So that the Blood, by this kind of Anastomosis, is continued, by an uninterrupted Course, from one into the other. Whence we may conclude, once more, that it is discharged by the abovesaid lateral Appendices.

The menstrual Blood is principally discharged from the uterine Vessels, as the Relaxation of the *Os Uteri*, and the stigmatic or red Spots, &c. observable in the Uteri of those Women who have died during their Evacuations, are a sufficient Proof of it. Moreover, in the *Hydrops Uteri*, &c. wherein the *Os Uteri* is inclosed, Women have little or no Menstrua; nevertheless, several Observations assure us, that, in the above Cases, the Vagina has sometimes afforded very considerable Menstrua, as we also observe in Pregnancy. Nor is this to be wondered at, since the Structure of the Vagina is somewhat like that of the Uterus.

Thus we suppose that there is a preternatural Plethora or Plenitude in the uterine Vessels, otherwise it would be inconceivable how the Blood could expand and open the said Appendices: Moreover, this Infarction of the uterine Vessels is proved by various Symptoms of the menstrual Evacuation; as Weight and Pains in the Hypogastrium and Region of the Kidneys, Heat of the Urine, &c. This particular Plethora is more

or lefs intense, according to the general Quantity of the whole Mafs of Blood; yet, though we extract double the Quantity of the menstrual Discharge from the whole Mafs of Blood, by Venesection; it will not be so wholesome, nor check the Violence of the Symptoms so well as the ordinary Quantity by the uterine Vessels.

Add to this, that there are some reduced, impoverished Constitutions, which have regular Evacuations, yet have no general Plethora. All which, I think, evidently proves the Necessity of a regular one.

But whether this particular Plenitude is formed by the Structure of the Veins, their Anastomoses, &c. as Dr. FREIND * imagined, I am not sure: For these cannot obstruct the Circulation of the Blood in the Uterus, nor collect a sufficient Quantity at the stated Times of Menstruation. So that we are to seek for some more evident Cause, which Dr. ASTRUC derives from the Compression of the uterine Veins by the periodical Distension of the Colatoria Lactea of the Matrix; which necessarily lean on the yielding Veins within their Reach; and the Veins, being once distended, compress the Colatoria in their Turn. To this add, that the Heat of the Blood, in the distended Veins, rarefies and dissolves the lacteal Liquor of the Colatoria, whereby it becomes more fluid.

Thus Women, at the Approach of their Menfes, commonly have their private Parts bathed with a lymphatic or thin lacteal Liquor, for three or four Days before the sanguineous Evacuation.

This chylous Flux sometimes only attends and streaks the sanguineous Vessels; nay, it frequently follows it only. Thus the uterine Colatoria and Appendices mutually compress each other, till

* Vid. his Emmenologia.

they exonerate themselves of their superfluous Contents.

The Site of the Uterus, the Defect of Valves in the Veins, the Want of the muscular Action to promote the Circulation, and the lateral Pressure of the incumbent Fluid, may also contribute to this Discharge: Thus we see that the Uterus, with respect to all the other Viscera, is, by far, the most proper and best contrived for the Evacuation of the Menfes.

These are simple and undoubted Principles, which yet are not more true, than easy to be understood.

Some Authors say, that no Animal is subject to the Catamenia but Women and Apes; yet we may justly affirm, that all other Animals are; particularly Bitches, when proud; nay, all other Animals, when in that State: Which, I own, does not happen so frequently, or regularly, as in Women or Apes; because they do not conceive so often as the latter.

OF THE DISEASES WHICH THE FEMALE ORGANS OF GENERATION ARE INCIDENT TO, EXCEPT VENEREAL INFECTIONS.

The Disorder, called by the Moderns Fluor Albus, not from the Word Flos, as some would have it, is very common among Women. It consists in an Efflux of a whitish, lymphatic, serous, or aqueous Matter, from the Uterus.

We are to observe, that the Colatoria Lactea, distended with their Contents, compress the Veins; these, once dilated, compress, in their Turn, the Colatoria, which, in the present Case, yield so far, as to discharge their Fluids by the Orifices of the Vesiculæ Lactææ. But it may be asked, Why it does not pass this Way, as it comes from the lacteal Fluids? The same Thing may be demanded with respect to the Milk of the Breasts, when suppressed.

pressed. As to the latter, it is diluted, and, as it were, embalmed by the Lymph in the mammillary Vessels; whence, being sufficiently fluid, it is carried off by the axillary Glands, and thence into the Blood. The very same Thing happens in the said Case. The Uterina Lactea being carried from the Matrix too largely, in the Bifurcation of the iliac Vessels, thence into other Glands near the Kidneys, &c.

But if the lacteal Matter be too spissid to pass through the small Vessels, it will settle in the Vesiculæ Lactææ, which it obstructs, or forces at length.

The first Cause is, the too great Plenitude of the uterine Colatoria. For what is more natural than that this Humour, thus collected, should have the above Effects?

Let us suppose as much in ten as in twenty-seven Days should at last overcome the Resistance of its Vessels; the Redundancy of the Humour is observable in Women who live well, have little Exercise, and lead a sedentary Life; whilst we see Persons of a different Regimen, and Manner of Living, such as Country People, &c. are rarely subject to this Disorder.

Women thus affected, have sometimes a small Quantity of their Menfes; in ten Days afterwards, a Fluor Albus appears, and so on alternately.

2. A preternatural Tenuity, or serous Diathesis of the uterine Lactææ, having almost lost its Colour, passes and slides so easily by the Orifices of its Vessels, that they cannot put a Stop to it, tho' they be well conditioned. This, I say, springs from the Retention of a serous excrementitious Humour; as Urine, Transpiration, &c. Or from a constant Drinking of mineral Waters, Passions, Watchings, Exercise, &c. Or from slow Fevers, or other preceding chronic Disorders; or too great
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an Attenuation of the Blood by Aperitives, as we see frequently by the Remedies given in a Suppression of the Menstrua.

If this Humour be very fluid, the Flux is continual; if only in a moderate Degree, it is periodical. In the former Case, the Menstrua are little or no way diminished; but, in this, they are considerable. The Importance of this Reflection will be explained hereafter.

3. The Relaxation of the Orifices of the Vesiculæ is frequently the Effect of a vicious Conformation, as may be seen from the Patient's Temperament and lax Texture of Body. It may also proceed from frequent Pregnancies, which attract a great Quantity of Humours to the Uterus, whereby these Vessels are relaxed, especially if the Blood be very ferous.

Lastly, This may proceed from the Dissolution of obstinate Obstructions of the Uterus. For the excessive Distension of the Solids, during these Obstructions, relaxes them so much, that, after the Cure, a Fluor Albus frequently follows. To these add the too frequent Use of the venereal Action.

As to the third Species of the Fluor Albus, or the lymphatic one; this is owing to the Transfusion of the Lymph through the tender and dilated Tunics of its Vessels, as we see in an Ascites, and other Kinds of Dropsies; which cannot happen without some kind of Compression, to put a Stop to the Circulation of the Lymph: So that, in lieu of a direct Circulation, it gets a lateral one. This Compression proceeds from the Obstructions of some of the larger uterine Glands, particularly that in the Bifurcation of the iliac Vessels; or it may arise from the Scirrhus of the Colatoria Lac-

* The second Cause, or Tenuity of the Humour, is rarely without Acrimony; which Remark is of Moment in the Cure.

tea, or the Relaxation of some Part of the Uterus. The above Obstructions frequently proceed from a scorbutic, scrophulous, or verotic Virus; nor is any Thing more common, than to see also a fluor Lymphatic from the Obstruction, &c. of the abdominal Glands. The Obstructions, Tubercles, Ganglions, &c. of the very Glands and Substance of the Matrix, though these Vessels are very small, may, nevertheless, produce this Disease. As the above Relaxation of a Part of the Uterus gives Occasion to the varicose Dilatation of the lymphatic Vessels; whence the Lymph easily transfuses; or they may be weakened through Corrosion or Exulceration, whereby the same Effect follows.

1. We are to observe, that a pure or simple Fluor, whether lacteal or lymphatic, is very rare: So that one Day it is more lacteal, another more lymphatical. For their Causes have such Analogy to each other, that sometimes they combine both, sometimes all three, together; rarely one alone is met with: So that the Variety is infinite.

2. Some Women have a regular and periodical Fluor Albus in lieu of a sanguineous Menstruation, through the great Quantity of Urine they make; the Sanguification thereof bearing no Proportion to it. Moreover, the constant Plenitude of the Colatoria Lactea hinders that of the sanguineous Veins. Likewise we may observe, in general, that the more the Fluor Albus is augmented, the sanguine Evacuation is diminished, and è contrario.

OF THE DIFFERENT KINDS OF FLUOR ALBUS.

The first is from the simple Plenitude of the Uterina Lactea; the second from that and a Mixture of Lymph: So the Causes of both are combined. The third proceeds from Transudation of the Lactea alone. We observe, that the second
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may be more or less abundant of serous or lymphatic Matter of different Colours; as yellow, brownish, green, or blackish: All which may be owing to the Mixture and various Colour of the Bile; or, as I am inclined to think, they may proceed from the Mixture of the Blood, if a Vein be corroded or lacerated, as to make the different Colour of Saliva.

Thus a small Quantity of Blood will render the Fluor yellow; and a little more will make it of a brown Colour. This Fluor may be very acrid and caustic, so as to excoriate the Vulva. The Fluor Lymphatic is commonly of the first Kind, though sometimes more or less in Quantity, according to the Diet of the Person; yet it seldom quite ceases, as it supposes a permanent Vice; whilst the lacteal Fluor is generally periodical, being the Effect only of simple Plenitude; yet it may be more or less augmented, according, also, to the Person's way of Living, &c.

The Diagnostics of the Fluor Albus are these.

1. It can hardly be confounded with any other Disorder but a purulent Effusion from an Ulcer of the Uterus, or a Gonorrhæa; yet the sensible Difference between Pus and the Fluor Albus, renders the Distinction easy. By Inspection, or Odour, which is always somewhat foetid, and rarely to be met with in the Fluor Albus. The Inflammation, Pain, Heat, Fever, &c. which preceded the Suppuration, and which never proceed from or attend the Fluor Albus, if not inveterate, are also Augmentations of the Pus. Finally, The Quantity of the Fluor Albus is much more considerable than that of the Pus, which distils but by small and few Drops; but if the Pus and Fluor be combined, the Case is still more difficult: Yet Attention and frequent Examination may distinguish it: The particular Qualities we shall consider, in Disorders

orders of the Breast. To these add, that, in Ulcers of the Uterus, there is now and then acute Pains, and the Patient cannot bear Coition; but the contrary in the Fluor Albus.

2. It is extremely difficult to distinguish the Fluor Albus from an inveterate Gonorrhæa, tho' proper Attention, and a competent Knowledge of each Disease, will demonstrate them, when recent. The incipient Clap is attended with a Phlogosis of the external Genitals, Dysenteria, painful Copulation, Heat, and Irritation of Urine. The Pain and Phlogosis are mostly observable in the Lacunæ about the Clitoris; but all these Symptoms are never met with in a Fluor Albus. Moreover, this Fluor augments by Degrees; and the Gonorrhæa comes to its Height suddenly: But if the Clap is inveterate, all or most of the Accidents vanish; whereby it approaches nearer to the Nature of a Fluor Albus; so that a Physician may thereby be the easier deceived, if the Patient be not very careful to give an exact Account of the Beginning of the Disease; for thereby you may judge whether it is an inveterate Clap, or no. But the surest Way to know is, by inspecting the Parts carefully, to examine the Lacunæ particularly, and Emissaries of COWPER'S Glands, which, if they ouze out a purulent Matter, the Infection is a Gonorrhæa, which may be also seated in the vaginal Glands. We are also to observe, that, in the Fluor Albus, the Orifice of the Uterus is generally lax and mollified; but, on the contrary, in a Gonorrhæa the Symptoms of the Fluor Albus are, 1. A Pain and Weight in the Region of the Loins, which are less permanent and sensible in the Fluor Albus, Lacteus, and Semilacteus, than in the lymphatic Fluor; because the last is accompanied with an œdematous Swelling and Distension of the Uterus.

2. Turbid Urine, which is owing to the Mixture of the Humour discharged by the Vagina with the Urine, as we see in Menstruation; wherein some of the Blood is mixed with the Urine, tho' some ignorant Practitioners imagine, that the Urine has otherwise acquired this Colour.

3. These Women are commonly barren; because the interior Surface of the Matrix is infarcted with a lacteous or gelatinous Matter, which prevents the Transudation of the Semen; or they are exposed to Abortion, whether they be impregnated before or after, as the Texture of the Uterus is made lax by the continual Efflux of Humours, which hinders the firm Adhesion of the Placenta to the Matrix. They are also subject to Distaste and Longings, like pregnant Women: For the Fluor Albus draining away the digestive Matter, the Remainder being vitiated, they connect, and excite the usual Sensations in the Stomach, &c.

From Indigestions proceed the Spissitude and Crudity of the Blood; whence arise various Obstructions and œdematous Tumors of the Feet by Day, and of the Face by Night, through the different Situations. Therefore, in this State, the Blood is so impoverished, that a Marasmus supervenes, the Quantity of Spirits is diminished, muscular Motion, particularly that of the Heart, weakened, and the Propulsion of the Fluids begins to languish; to which add, the Attenuation of the Blood by a slow Fever, from the Retention of the excrementitious Substances, want of Nutrition, &c. all which concur to produce a Coldness of the Extremities, difficult Respiration, frequent but weak Contractions of the Heart, Palpitations, Syncope, &c.

Sometimes a total or partial Uteri Procentia happens through the Relaxation of the urinary Ligaments.

If the Fluids of the Fluor Albus be acrid and corrosive, it exulcerates the Vulva, creates a Phlyctaneæ, &c. which generally happens, if there be a Scirrhus or cancerous Ulcer in the Matrix, from a Virus, Variolicum, or the like.

The Thinness and acrimonious State of the Blood, the slow Fever which generally is present, or in an inveterate Fluor Albus, with the various Obstructions already mentioned, produce Dropsies of different Sorts at the Parts, and sometimes Hydatides, very large, and containing several Pints of Serum; till, at length, the Patient dies dropfical, or consumptive.

In general the Fluor Albus is very incommodious, which renders Women disagreeable to Men. All that we have observed make this Disease very troublesome and tedious, and also difficult to cure; nay, mortal sometimes, if it be that Species of lymphatic Fluor Albus which creates Ulcers, Cancers, &c.

The Procentia, Prolapsus, Descensus, &c. Uteri, is a very common Disorder. The Uterus, in this Case, presents itself in the Vagina, between the Labia Pudendorum, or is internally prominent, and visible without the Vulva. The vaginal Membrane may have these different Degrees of a Prolapsus, as its thin corrugated Texture proves, when visible. Sometimes it is the Substance of the Uterus which appears so. Hence there are two Sorts of Procentia to be observed in this Case; one of the Vagina, the other of the Uterus. That Part of the Vagina which prolapses, is only a Duplication commonly of one Part of its internal Membrane; as for the Matrix, though its Substance thus appears, it is never inverted, as some Authors imagine. Dr. ASTRUC's Diseases of the Uterus.

A Portion of the Vagina prolapses through its Relaxation and Distension, as the Anus of Children through its Laxity. The Causes of this Relaxation are by difficult Labours, or the Situation of the Fœtus in Utero, its large Size, &c. or sometimes through the violent Introduction of the Midwife's Hand, or Forceps, before the Os Uteri is sufficiently dilated, or the Child left too long in the Passage of the Uterus and Vagina. Thus the external Tunic of one is distended, relaxed, and, as it were, gathered into Plicæ; whilst the internal or muscular one contracts itself: Hence they are by degrees lengthened, and advanced to the Vulva. The same Thing may proceed from an habitual Fluor Albus, either from the Uterus, or Vagina, which perpetually bathe these Parts, and hence relax them; therefore we rarely observe an inveterate Fluor Albus without a *Procedentia Uteri*: And an *Anus Descensus* likewise happens in Consequence of habitual *Diarrhæas*, or the Relaxation of the muscular Fibres.

The Uterus prolapses, yet is never inverted, as some Authors imagine. Is it probable, that this compact Organ should be so relaxed as to pass through its Orifice, in Inversion, as several Authors would have it?

There is sometimes a Polypus in the Vagina, which often deceives one. *ASTRUC* relates a Tumor, which weighed five Pounds, taken off by a Ligature from a Lady about fifty Years old, who had had several Children, and afterwards had an habitual Fluor Albus. This Tumor, I own, had so great a Resemblance of the Uterus, that it might have imposed on a great many for the Matrix: Which shews how cautious we ought to be in examining well any Part, before we give an Opinion.

The Uteri Prolapsus is rarely dangerous; for Women bear it a long Time. I have seen some
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who were afflicted with it for thirty Years. It must be very disagreeable and incommodious, not only to the Patient, but also to those who cohabit with her; or it may be dangerous, by the Inflammation, Scirrhus, Carcinoma, &c. which it induces.

But if it be slight, incomplete, and without any permanent Vice, in a young Woman, &c. it is the more supportable: On the contrary, if it be large, inveterate, inflamed, scirrhus, or carcinomatous, in an old Subject, &c. it is extremely troublesome and dangerous.

The Ovaria and Tubæ Fallopianæ are subject to most of the Disorders incident to the Uterus. Both are sometimes affected at the same Time; but the Ovaria and Tubæ Fallopianæ are frequently diseased alone, and independent of the Diseases of the Matrix. In the Ovaria are sometimes observable hairy Tumors, whose Explication has puzzled the Brains of many. These, I think, are nothing else but abortive Conceptions, which form a kind of steatomatous Tumor, being, as I suppose, an Embrio putrefied therein: Sometimes the Tubæ Fallopianæ, being relaxed, may drop into it.

Various Disorders happen to Women in Consequence of the Retention of their seminal Fluids in Coition and Erythismus: Hence arise Dropsies, steatomatous Tumors, &c. of the Ovaria, as in the Male Testes; whence happen a Spermatocoele and Schirrus of those Organs.

Dr. ASTRUC is said to have been present at opening a Subject who had one of the Tubæ Fallopianæ so much distended with Serum, that most of the Inspectors imagined it to be a second Uterus.

As to the Cure of this Disease; these Organs are to be treated in the same Manner as Inflam-

mations

mations of the Parts affected, frequent Bleeding, Diluents, &c. or, like cold Tumors, with Aperitives, Purgatives, &c. as the Abscess; which, of these Organs, is sometimes happily evacuated by the Effort of Nature itself; but, if the Pus remains in the Abdomen, the Effects frequently prove mortal.

OBSERVATIONS.

The cutaneous Labia, rising in two Ridges, were stretched in such a Manner, as for the true Vulva to contain likewise the Anus, and terminated a little above it: The Nymphæ were very large, measuring one Half of the Length of the Vulva; and between them and the Labia was the Fossa Navicularis, larger than usual. By the Furcula, the Hymen, the proper Orifice of the Vulva, and the other Parts belonging to it, did not at all deviate from their common Structure. HALLER'S Patholog. Observ. LXI.

The same Author relates, that a young Lady had a double Vagina, and a Uterus on the right and left Sides of the Pelvis, both intire, and of an oval Figure; but there was only one Ovarium to each, as also one spermatic Vessel, with a Cervix and Valves disposed into Branches, all in the natural Situation.

Each Uterus had its distinct Vagina: The anterior continued to the right Uterus, and the posterior a little below its Orifice opening into the left by a small Orifice not above a Line broad: These two Vaginæ were parallel to each other; but there was only one Kidney. Ibid. Observ. LX.

In another he found the Ovarium so tumified, that, at first, he thought the Subject was pregnant; but, on examining the Part, the Uterus was found in its proper Situation, only contiguous to the superior Part of the Pelvis; where two Tumors appeared separated from one another by a small intermediate Cavity. Ibid. Obs. XLII.



LECTURE XVI.

Of the various Opinions, both of the Antients and Moderns, concerning the GENERATION of the HUMAN SPECIES.



F all Physiological Inquiries, none, perhaps, discover so much Sagacity as those concerning the Nature of the Generation of the Human Species.

The Testes are those wonderful Organs by which is formed that generative Fluid which has been, and is, the Occasion of Procreation of Animals.

The Pressure of their Tunics, the Elasticity of the Fibres, and the Pulsation of the Arteries, propel the Fluid through the Corpus Highmori Canaliculum.

How does the Semen, which is filtrated, contribute to form Man? Is it an occasional Cause, by which the Supreme Being is determined to form the Embryo? Is it a Substance in which Ideas are inclosed, or plastic Nature, which gives it different Configurations? Is it a simple Fluid which contains Animalculæ intirely formed, or only unfolded? All these Opinions, though chimerical, have their Assertors.

If I may be allowed to say something in so great an Obscurity, the first Opinion, I believe, cannot
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be defended. If the Author of Nature sought but an occasional Cause, was it necessary to make so great an Apparatus for a Fluid? It is true, this Difficulty is easily answered. It may be alledged, that this Apparatus is only to give a Perfection to the Semen, of which it had need afterwards to produce certain Effects in the Body which are peculiar to Men. What we may here say is, that perhaps it may be so; but it is not probable. The first View which the Author of Nature seems to have proposed in forming the seminary Canals, is, for the Generation of our Species.

The second Opinion has been defended by many Philosophers: There are Phænomena which seem to prove that plastic Nature is dispersed in Matter, to give it divers Configurations. Plants partake of it: When one Branch is cut, there arises another. But what proves the Existence of plastic Nature in most Animals, is, the Cray-fish: For if one of its Claws be cut, another is produced in its Place, as the Branch of a Tree. Let a Joint be cut off, or that which is above it, it all rises again in the same Order. These are wonderful Productions! That which is under a Joint is separated from that which is above, and is only united to it by Ligaments. It does not seem that one is a Production of the other. Besides, there are Muscles inserted from the two Extremities, in the Parts which are below the Incision. We cannot say that this is only an unfolding: Many Parts cannot be reputed the same, before their Expansion; but it should be in the same Manner as if there were an Unfolding, if the new Claw, which grows again in the Cray-fish, arises from the same Part, and performs the same Functions.

The third Opinion cannot subsist, if the first be true; unless they will affirm, that the plastic Na-

ture forms even Seed, the Rudiments of the Embryo: But we cannot say that those Animalculæ, discovered in the Semen, can be Man in Miniature.

1. It is certain, that there are Animalculæ found in all the Fluids of the human Body. 2. In the Liquor which Women emit in Coition, are contained Animalculæ, as well as in those of Men. 3. Supposing all this not to be so, there could be no sufficient Reasons given to conclude that it is so: For when the Parts of these Animals were to be extended, the Progress of the unfolding would not be as those which we shall take Notice of in the Embryo, where nothing is less observable than an Animal intirely formed. This Opinion was at first received.

1. That there have been Animalculæ discovered moving in Semen. 2. LEWENHOECK has extended his Discoveries through a Microscope so far, that he pretended to have distinguished the Sexes in these Animalculæ. 3. It has been observed, that they are not found in those who are much addicted to Venery. This agrees with Experience; which teaches us, that those which are given to Women, seldom propagate. 4. It has also been observed, that the Animalculæ, which are in the Semen of young Persons, are more vigorous than those of old ones, who die immediately after Emission. This may be the Reason why old People are not prolific.

Several Hypotheses have been built on this Principle.

Some were of Opinion, that the Semen, being injected into the Matrix, these Animalculæ devour each other; and that the last, which was nourished by all the others, formed the Embryo. Others think, 1. That these Animalculæ entered the Ovarium through the Fallopian Tubes; then

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crawled on the first ripe Ovum they met with, which they entered through the Aperture, where there is a Valve to prevent their Return: And as many are ripe as there are Embryos; because so many Animalculæ introduced themselves therein.

It is evident, that this Description is the mere Production of Imagination, which is very ill founded.

Monsters certainly spring from two different Species; partaking of both. Some have the Head of one Species, and the Body of another; others have the Feet of one, and the Jaw-bones of another, &c. In order that this may agree with the System of Animalculæ, these Monsters should be formed in the Animalculæ which are dispersed in the Semen: But it is in our Power to compute Animals of different Species; every Time they copulate, will ingender Animals of two different Kinds. Would it be possible that a little Monster should be instantly found in all these Copulations? Besides, it cannot be denied, that the Ideas do not always modify Matter. The Marks which appear in Infants, whose Mothers have had a strong Desire after something, commonly called Longings; the odd Figures with which Fœtuses have been marked, according to the Imaginations of the Mother; all these prove the Action of the Ideas. If this be so, the Opinion which imputes the Generation of Animals to Animalculæ, cannot, I think, take Place. For, according to the Objects striking the Imagination, there are found in the Fœtus Parts organized, whose Rudiments were not in these Animalculæ.

This being granted, we may conclude the Existence of plastic Nature. TANTÆ MOLIS ERAT MORTALEM CONDERE GENTEM. See Physical Essays.

In regard to *Animalculæ*, they are now discovered even in clear Water; an Account of which we have in the *Philosophical Transactions*.

According to *PLATO*, Man is the only Image of the creating Power; and the Essence of all Generation consists in the Unity of Harmony in these three; viz. the Subject which procreates that in which Generation is performed, and that which is produced.

To cast a stronger Light upon those sublime Notions, he adds, that the Succession of Individuals is a fugitive Image of the immutable Eternity of triangular Harmony; which Doctrine has been much venerated by the Antients.

But if ever he had any Conception at all of Generation, it probably was either very confused, or else he chose rather to make it a Mystery to us.

The Ideas of *ARISTOTLE* (in his Book of Generation) do not lose themselves after the same Manner in immutable Eternity. He confines himself simply to Matter, which will have it that the *Fœtus* is formed, enveloped, and nourished, by the menstrual Blood of the Mother, after the Mixture of those *Menstrua* with the seminal Fluid of the Male, which acts as the Cause or Principle of generative Motion.

That the human *Fœtus* is nourished by this Liquor, is beyond Dispute; but its being originally formed from it, is an Opinion intirely exploded, since the Time of *ARISTOTLE*. Besides, all Females of Animals have not a menstrual Discharge.

HIPPOCRATES, to prevent Jealousy between the two Sexes, has artfully insinuated, that commonly they both concur to Generation; and thence infers, that the seminal Fluids, from the Male and
Female,

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Female, are both prolific; and that each of them consists of two different Particles; one strong and active, the other weak and sluggish: That the stronger, being united, produced the Male; and the weaker, the Female. So that, probably, the stronger, being mixed with the weaker, produced the Hermaphrodite.

DES CARTES attributes the Formation of the Fœtus to neither of those two Seeds, but to the Fermentation of both, when mixed.

FABRICIUS AB AQUAPENDENTE is perhaps the first who has observed the Fecundation and Development of Hens Eggs; and the Result of his Inquiries was, that the glandulous Cords, which run across the White, to join with the Yolk of the Egg, being fecundated by the feminal Spirit of the Male, are the Instruments which serve to the Production of the Fœtus.

ALDROVANDE, upon Generation, is almost an ARISTOTELIAN. See his Ornithologia.

PARISANUS says, that the Seed of the Cock, or at least that white Point which is in the Middle of the Cicatricula of the Egg, is the Substance which produces the Chicken. This was advancing towards it. But had he said that this Substance was the Chicken itself, he would, perhaps, have come nearer to the Truth.

OF THE OVIPARISTS.

In Matters of Physic, general Systems are readily received, but no true one has yet appeared. From the Discoveries made upon Eggs, the Generation of viviparous Animals has been deduced.

STENO, to that End, supposed Ovaria in them; whence he was looked upon as the Chief of the Oviparists.

GRAAF has presumed to appropriate to himself this Discovery; but without entering into any Discussion of this Point: At least it follows, from their Contest, that GRAAF supposed, with STENO, Ovaria in viviparous Animals.

HARVEY also allows Ova in all Females; making no other Distinction between the oviparous and viviparous Animals than the different Manner after which the Fœtuses of either are nourished, and receive their Growth. The Generation of those Ova, according to this Author, is the Performance of the Matrix, which conceives only by a kind of Fermentation, communicated to it by the feminal Fluid of the Male: And, in order to give a true Idea of this Mechanism, he says, that the Matrix conceives the Fœtus, as the Brain does Ideas. He undoubtedly wrote for those who already knew how Ideas are formed.

VERHEYEN followed the same Doctrine; with this Difference, however, that, for the Formation of the Fœtus, he established the Intromission of the Male Seed into the Fundus of the Matrix, without depending upon the Fermentation of HARVEY. This Contagion was really exposing the Modesty of Virgins to numberless Accidents.

WILLIAM LANGLEY was also an Oviparite. His Observations run in the same Strain with those of HARVEY.

JOSEPH DE AROMATARUS has first observed, that the Chicken is already formed, in the Egg, before Incubation.

MALPIGHI is also convinced of the same Opinion; and observes, that the white Apex, which, according to HARVEY, becomes the animated Point, is only a small Bubble, which contains the Embryo, the rough Cast of which increases in Proportion as it developes itself; whereas no such Thing is found in the Egg of a Hen never trod by
the

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the Cock. Whence it is very probable, that it was the Cock which introduced the Chicken into the Egg.

MALPIGHI, however, has not drawn this Consequence from his Observations; for he thought that the Fœtus pre-existed in the Egg, and imagined to have seen it therein before the Coition of the Cock.

VALISNIERY has made new Discoveries, but has reaped no Advantage from them. By his Observations he proves, that the Testicles in Females produce no Eggs, but that they are only Reservoirs of the Lymph, or of the Fluid, which contributes to Generation; and yet concludes, that the Work of Generation is performed in the Testicles of the Female, as well as in those of the Male: And, with HARVEY, does not think that it is necessary the Male Seed should enter into the Matrix to fecundate the Egg.

NUCK alledges Experiments in Favour of the Ovaria.

DU VERNEY was also an Oviparite; and his Opinion has been much in Vogue among Anatomists; but most strongly opposed by MERY.

OF THE VERMICULISTS.

HARTSOEKER and LEWENHOECK were the first Authors of the Sect of Vermiculists, or those who thought to have discerned, in the Male Semen, Animalculæ like Worms.

ANDRY, VALISNIERY, BOURGUET, and many other Authors, have thought the same.

DALEMPATIUS asserts, that he observed a Species of Bull-heads or Tadpoles therein, which developing themselves, became distinct human Figures.

And

And the Vermiculites have supposed those Animalculæ or Tadpoles to contain Fœtuses in their primitive State.

Some of this Sect, not having intirely laid aside the oviparous System, in order to reconcile both the Sects, pretend, that of a Million of Animalculæ, which float in the Semen, one or two only, and very seldom three, become perfect Fœtuses; and that all others perish, not being able to pierce that particular Part of the Pellicula through which they are to penetrate, and lodge in the Ovum, or Egg; this Aperture closing up, by a Valve, as soon as any have entered it.

OTHER OPINIONS MORE GENERALLY RECEIVED.

The Author of the *Venus Physica* establishes the uniting of the prolific Seed of both Sexes, and admits of what may be called the Redundancy of those Fluids.

M. DE BUFFON was, in a great measure, inclined to the System of HIPPOCRATES. He attributes to the Female, as well as to the Male, seminal Fluids, each of which contain organical Moleculæ, from the uniting of which a new Animal is formed.

SUMMARY REFLECTIONS ON THE VARIOUS OPINIONS OF ALL THE AUTHORS BEFORE CITED.

In the first Place, we should ask those who divide Generation between the Male and the Female, Upon what Grounds they suppose the Male Seed, in order to Fecundation, to stand in Need of an extraneous Juice, or a cold Fluid, such as that which the Female produces in Coition,

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tion, whilst it is, of itself, endowed with a Matter more warm and subtil?

In the next Place, if the Co-operation of the Female be necessary to the Formation of the Fœtus, we may ask, How some Animals ingender without Females?

Are we then to admit of two Sorts of Generations? And why should the Laws of Nature be multiplied, without any manner of Necessity, by supposing two of them; whereas one, only, is sufficient, in all Cases?

One Consequence, in the System of Oviparists, I think it hard to admit of; which is, a Progression decreasing, ad infinitum, of Eggs contained one within the other.

Besides, those Eggs, being only a cold and lifeless Substance in oviparous Animals, and which never had any Existence in the viviparous.

The Proof intended to be deduced from it, in Favour of the Existence of Eggs in viviparous Animals, or of Fœtuses found in the Abdomen, or Fallopian Tubes; admitting them as Facts, to me seems not conclusive; since it is very possible that the Seed of the Male might have introduced itself into those Tubes, in Consequence of their Dilatation; and that it either abides therein, or falls into the Abdomen, through the *Morsus Diaboli*, or the fringed Membrane.

Wherefore, in this Case, in lieu of the Fœtus falling down from the Ovarium, it is more probable, that it has reascended into the Tubes: For, otherwise, why should no Fœtus ever have been found in the Ovarium?

A complete Confutation of the System of Oviparites, is to be found in the Works of M. DE BUFFON.

The System of Vermiculists seems to be no better grounded; since the Truth of those Animalculæ,

culæ, floating in the Seed, appears to me but faintly established. For who, among the vermiculite Physiologists, is able to assert, that those Animalculæ existed in the Animal itself, before the Emission of the Seed? Or disprove that they were formed therein since the Fermentation or Corruption of the seminal Fluid, such as are found in Vinegar, which did not previously exist in the Wine; or such as are seen swimming in putrefied Water, which did not exist before Putrefaction?

To prove their Existence, I could wish that those Bodies were transparent; and that the Seed might be discernable in its very Receptacle: Till then, we have a Right to doubt, whether there be any Animalculæ in the Seed; or, at least, whether those Animalculæ are diminutive Men. For the Activity and Frisking which Vermiculites suppose in them, do not in the least agree with the Sluggishness and Inactivity usual in a Fœtus.

Hence it is not reasonable to imagine that those small Embrios, in Proportion as they advance in their Conformation, by their complete Organization, should lose their Vigour and Agility.

CONJECTURES ON THE FORMATION OF THE
FOETUS. By GAUTIER. Inserted in the
Merc. Paris. 1750.

The probable Conjecture, as to the Formation of the Fœtus, is; that it is produced, under a fluid Form, in the seminal Vesicles of the Male, by the Concourse of the Blood secreted by the Testicles, and that of the animal Spirits, which, during the Act of Coition, rush into the said Vesicles, by a Mechanism like that which has concurred to the Increase of the Parts of the ingendering Male; so as it is with those Insects which propagate without a Female, such as Polypuses, Vinefretters,

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fretters, &c. yet with this Difference, that, instead of the Young of Insects, drawing their Nourishment and Growth from the Earth itself, or Plants, which serve them as a Placenta does the human Fœtus, as well as those of other Animals, is formed in the Matrix of a Female, there to receive its Nourishment and Increase. In order to undergo this Transmutation, it comes forth extremely feeble, and even fluid, from the seminal Vesicles through the Verumontanum, and is ejected through the Urethra into the Matrix.

This, then, according to my Supposition, is a kind of Production from the Male, whence it has even received Nourishment, during some Moments, by means of the Fluid, which, proceeding from the Prostatae, also serves, at the Instant of the Emission of the Fœtus, to preserve it, in its soft and weakly State, intire, by the Invelopement it surrounds it with.

The Fœtus, being conveyed into the Matrix, is immediately nourished there by the Semen of the Female, during the Time of its floating; and, when fixed, is, by the Anastomosis of the sanguineous Vessels, conveyed through the Placenta, during its Stay in the Matrix.

This first Nutrition, which it receives from the Semen of the Mother, enables it to wait till it be supplied by the menstrual Blood, transmitted by the umbilical Vessels, which take Root in the Matrix. Consequently it would be, in a Woman, a Defect capable of preventing Generation, if she was not in a proper Condition to supply Nourishment to the Fœtus after she has conceived.

To confirm my Conjecture, it is to be observed, that in all Male Animals are found two different Sorts of Semen; one clear and transparent, which probably is not the generative Fluid; the other more concocted and adhesive; wherein, by a pro-
per

per Inspection, the Fœtus is easily discerned. In one Ejaculation of the human Semen, generally one Fœtus only is to be discovered, though sometimes two, or more, may be discernable; whereas in Quadrupeds, which are more fruitful, several may be seen floating in a clear and viscid Fluid, produced by the Prostatae.

But if the Semen be interrupted, no Fœtus is to be found in it, at least not intire, but only some imperfect Particles thereof.

The Oviparists, such as are the Females of Birds, Serpents, &c. being unprovided with a Matrix to preserve the Fœtus, have, instead thereof, Placentæ for its Nourishment. These are the Placentæ which, in the Females of those Animals, form what is called the Bunch of Grapes; and the same viscid Matter which wraps up the Eggs, also envelopes the Fœtuses fastened thereto.

As to Fishes, the Male needs only cast forth his Sperm at the same Instant when the Female ejects her Eggs; and considering the vast Quantity she emits, some of them always meet with Sperm, and adhere thereto.

According to my Principles, I meet with no Difficulty to explain the Formation of Monsters, arising either from an Excess or a Deficiency of Semen; which is performed in the seminal Vesicles of the Male, either by the Concretion of two Fœtuses confounded together, which very easily happens (the Substance of them being at that Time so soft and feeble), otherwise, by the Mutilation of the Fœtus at the same Time, which may as easily happen, for the same Reason.

Neither, in this State, is it in the Power of the Mother to prevent the Fœtus from receiving any external Impression, Blemish, or Defect, whether proceeding from any Longing, Surprise, Passion,
or

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or any Thing that causes any irregular Motion in the Animal Oeconomy.

The Resemblance which is often observed between the Child and its Father or Mother, implies nothing contradictory to our Opinion; and is no more difficult to explain by our Principles, than any other Hypothesis upon this Subject.

The Generation of Mules, itself, supports our Sentiment. Those Animals produced by the Male Afs, in Conjunction with a Mare, partake of the Nature of the Sire, whatever chiefly belongs to Conformation; such as the Head, Ears, Rump, and Tail; and of the Mare, scarce any Thing else besides the Bulk and Hair. So that they are, properly, large Affes covered with the Hair of Horses; yet they have, under their Bellies, some long Hairs, from the Afs.

If it be asked, Why Mules do not propagate? The Answer is, 1. That this Question is not particularly relative to our System. 2. That Instances might be cited of Mules which did ingender; and that there are daily seen Birds, of a mixed Species, which, nevertheless, do breed: And as much may be said of Dogs. 3. That probably this Degeneration proceeds from the heterogeneous Nourishment which an Animal has received in the Matrix of the Female, which was originally destined for an Afs. And since this Difference of Nourishment may be the Cause of the Deviation, as to Bulk and Hair; why may it not also alter the generative Faculty? Thus the Production of divers Species of Animals, and such like Phænomena, are easily explained by the System we here propose; which, besides, has this particular Advantage over all others; viz. that the Observations and Experiments made by all the Naturalists, who have adopted other Hypotheses,

so

so perfectly agree with ours, as though they had made them with a View of confirming the same.

Conformably to the Example of HARTSOEKER, who bethought himself (says the Author of the *Venus Physica*) to examine, with the Microscope, that Fluid which commonly is not discernable with the naked, though perceptive Eye; I will relate here a most conclusive Observation, made in Support of my System, by a more modern Physiologist, on whose Exactness and Fidelity I can depend. Previous to this, I must ask Pardon for it of my modest Readers, since it is impossible for me to suppress the most clear and decisive Proof of this Argument, without regarding whether the Curiosity of a Physician be blameable, or not. Here follows the Fact.

He received human Semen in cold fair Water, at its immediate Exit from the Urethra, wherein he saw distinctly, even without the Assistance of Glasses, a white Fœtus, consisting of an opaque and fluid Matter, the Head of which was larger than the rest of the Body by one Third Part. At the Extremities of the Trunk hung four Filaments, which formed the Arms and Legs; the whole Difference between this small Fœtus and an Embrio which has been lodged in the Matrix, is, that the Head was, at least, one third Part larger than the Body; and it is without Doubt that this Disproportion has prevented other Observers, who have made the same Experiment as my Physician, from making the same Discovery therein. They probably have taken the Head of the Fœtus for an Aggregate of Matter, more concocted, and thicker, than the rest of the Semen; likewise the Arms, Legs, and Body, for Parts of the same Matter, shooting forth into Filaments, by reason of their Viscidity. But the naked Eye suffices to convince

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convince an attentive Observer, that those viscid and whitish Lumps are true Fœtuses, the Parts of which being more distinctly perceived through Glasses, removes all manner of Doubt.

The same Physician has made the like Observation upon the Semen of Quadrupeds, and found, that none shewed more distinctly the Fœtus than that of an Ass, which dropped into a Vessel of Water.

He perceived therein a small Ass, formed of a yellowish, thick, and fluid Matter; and could easily discern a very large Head, Trunk, four Legs, and a Tail, floating in a diaphanous greenish Liquid.

He likewise made a third Experiment, which any Body may, if he pleases, repeat, after him. He opened a Hen, immediately after her having been trod by the Cock; wherein he discovered a Chicken already formed, of a white and fluid Matter, having a large Head, and the rest of the Body very small in Proportion; the Whole being fastened to the Yolk of the Egg, and surrounded with a glutinous transparent Fluid.

If such Facts, added to the Principles we have established, though they do not incontestably convince us that the Male alone, in all Animals, produces the Fœtus ready formed; and that the Matrix of the Female serves only as a Receptacle wherein the Fœtus is deposited, there to receive its Nourishment and Growth.

I confess, I have no stronger Arguments to offer, in Support of my Opinion; and I question whether the Adversaries to my System have any stronger to oppose.

In fine, this System, so far from containing any Thing either new, or repugnant to Reason, must be, on the contrary, universally received, as being

founded both on Reason, and demonstrative Proofs deduced from Experiments.

The first Philosophers before PLATO maintained, that the Semen of the Male, alone, contained all the Parts requisite to form a Body; and considered the Fluid, wherewith the Matrix supplied the Fœtus, as they did the Moisture which the Earth yields to the Nourishment and Growth of a Tree or Plant.

NON NOSTRUM INTER VOS TANTAS COMPOS-
NERE LITES.

REMARKS.

I must confess, that I have not yet met with any System of Generation that has given me the least Satisfaction; but, on the contrary, all of them appear full of Absurdities, and the Whole is so involved in Difficulties, that it is not an easy Task to explain it, notwithstanding all the Pains which have been taken, by LEWENHOECK, to contrive Glasses to observe Animalculæ in the Male Semen. Whence he, and his Followers, deduced a new System, as it should seem utterly romantic, and inconsistent with the Conduct of Nature observable in all her Productions. Thus, for Example, if 3000000000 Animalcules should be included in a Quantity of Male Sperm sufficient for the Production of a single Animal, provided the Animal is produced by one of these Animalcules, all the rest are superfluous, and created for no End but to be immediately destroyed; we may then suppose that Providence aims very oddly, if obliged to load her Engine so enormously, in order to execute her Design. But in all other Instances we find, that the Author of Nature perpetually adapts much less compounded Means, in order to arrive at the designed Scope.

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We have therefore great Reason to believe, that the Generation of the Antients is not the only Thing neglected, and accomplished in a Manner extremely inartificial.

With respect to these Animalcules, I must observe, that they really exist, and are easily discernable by the Help of Glasses; but never, as far as I have been able to discover, whilst the Semen is fresh and uncorrupted. But the Semen of Animals corrupts in a very short Time, and then the Animalcules appear; and, perhaps, not before.

Something analogous to this happens to the Seed of Vegetables. Wheat, for Example, ground into Meal, whilst fresh, exhibits no Animalcules; but, when mixed with Water into Paste, and corrupted, great Numbers of Animalcules are discoverable in it, by the Help of Glasses. Now it seems to be equally probable, that the Animalcules, discernable in Wheat, the Seed of a Vegetable, should be Rudiments of the future Blade of Corn, as that Animalcules, in the corrupted Semen of an Animal, should be necessary to the Production of another similar to its Parent.





LECTURE XVII.

Of CONCEPTION.

THE two most commonly received Opinions of our Time, concerning Conception, are, that Men, as well as all other Animals, derive their Origin, in the same Manner as Hens and Birds, from an impregnated Egg, in which all the Parts of the Creature are contained, in Miniature, in the female Ovarium.

Those of the viviparous Opinion say, that all the Parts, which are to compose the Fœtus, are in one of the *Animalculæ* of the male Semen.

What we are certain of is, that no Procreation can be performed without the Union of Male and Female*, for our own Species; and the male Semen should enter the Fundus of the Uterus.

In some Fishes we observe no Copulation, but only a simple Friction of their generative Parts, for their Progeny; but in our Species it is absolutely necessary that the Semen Virile be conveyed into the Matrix; and cannot be admitted but only at the Time when the Female emits the Semen from her Testes, as the Antients called it; which is certainly true: For no Woman can con-

* Some Naturalists observe, that Snails, Earth Worms, &c. do not require Copulation; as these Animals, to all Appearance, are really Androgynes: Nevertheless, they copulate sometimes with each other.

ceive but at that Time; notwithstanding what some Authors would make us believe.

MAURIEAU relates, that a young Lady declared to him, that her Husband never introduced his Penis into her Vagina but only between the external Labia. But when a Woman is in a Love Passion, I think it is in her Power to be very sensible what she does. Besides, in that State the Orifice of the Womb descends into the Vagina, more or less: Nay, some Matrices are situated lower than others; and therefore may the more easily receive the Semen.

As to what HARVEY says concerning Mares, &c. viz. that they may conceive, very often, by only a simple Approach of the generative Parts of the Male to theirs; I think most Grooms will contradict this Notion. For they observe, when the Mare does not retain the Semen of the Horse, she is not impregnated, or covered, as it is termed.

Conception is the Formation of an Embryo in the Uterus, by a Woman, receiving the Embraces of a Man, and his Semen into her Matrix, which excites a convulsive Constriction and Attrition of the very sensible and tender Parts which lie within the Contiguity of the external Opening of the Vagina, after the same Manner as we observed in Man. By this means, the Return of the venal Blood being suppressed, the Clitoris grows turgid and erect, the Nymphæ swell on each Side, as well as the venal Plexus, which almost surrounds the whole Vagina, so as to raise the Pleasure to the highest Degree: In Consequence of which, there is expelled, by the muscular Force of the Constrictor, but not always, a Quantity of lubricating mucous Liquor, of various Kinds; the principal Source of which is seated at the Beginning or first Opening of the Urethra, where there are large mucous Sinuses, situated in the protuberant Mar-

gin of the urinary Duct. Besides, there are two or three large Sinuses, which open themselves into the Cavity of the Vagina itself; and others on the Sides of the Urethra, at the Bottom of the Sinuses, which are formed by the membranous Rugæ or Valves fulcated superiorly. Lastly, On the Sides of the Vagina, between the Bottoms of the Nymphæ and Hymen, there is one Aperture, on each Side, from a very long Duct, which, descending towards the Anus, receives its Mucus from a Number of very small Follicules.

But the same Action which, by increasing the Pleasure and Delight, causes a greater Conflux of Blood to the whole genital System of the Female, occasions a much more important Alteration in the internal Parts: For the male Semen, penetrating the tender and sensible Cavity of the Uterus, which is itself now turgid with influent Blood, does there excite, at the same Time, a Turgescence and Distension of the lateral Tubes, which are very full of Vessels, creeping between their two Tunics; and these Tubes, thus copiously filled with florid Blood, are supposed to become erect, and ascend, so as to apply the rough or fringed Opening of the Tube to the Ovary, as is commonly believed.

The Semen deposited in the Vesiculæ Seminales is in the Testicles yellowish, thin, and aqueous; and it retains the same Nature in the Vesicles, only it becomes somewhat thicker, and higher coloured. It has a sort of heavy or strong Smell, of a peculiar kind, in each Class of Animals. Without the Conveyance of this Fluid into the Uterus, no Class of Animals, in each of which are two Sexes, can be fecundated so as to propagate its Species.

Since the Invention of the Microscope, we have discovered in Man, as well as in all other male Animals, the seminal Liquor is full of living Animalculæ

malculæ resembling Eels, only with larger Heads; and that these are always present in healthy Semen, from the Time, and in those who are sterile, from a Gonorrhæa, it is said they are absent. (That they are Animalculæ, appears evidently, from their various Motions, Restings, and Gestures of Body; tho' with Age they are said to dwindle, and lose their Tails).

It has been much doubted what can be the Use of these Animalculæ, the like of which are not to be found in any other Liquors of our Bodies.

Some think, that they excite Irritations which incline to the venereal Appetite; and others have had various Thoughts: However, the most commonly received Opinion is, that a seminal Animalcula is the first Rudiment of our Species, almost in the same Manner as a Caterpillar or Grub is, which owes its Origin to a Fly.

This seems to be approved of, from the near Resemblance of the Fœtus to its parent Stamen, from whence it was derived; which Stamen does not appear, unless the Female is fecundated by the Male. Moreover, this Opinion is confirmed; inasmuch as Animals, generated from the two Sexes, generally have a greater Resemblance to the Father than the Mother; insomuch, that Diseases and Defects of the Body and Mind run, for a long Time, through a Family, from the Grandfathers to the Children.

Add to this, that Insects commonly undergo a Revolution of their Parts, somewhat like this of the Vermicles into a Fœtus. These Vermicles are universally found in the Semen or Testes of Animals; and, consequently, they seem to be of some very important Use.

Many Arguments have likewise been advanced in Opposition to this Hypothesis, that the Generation

ration of the Parts of the human Body is not made suddenly, or all together; but slowly, or by Apposition: To which add, that Animals produced from a Mixture of different Kinds, as the Mule, &c. do not shew a perfect Delineation of the Male in several Parts of the Body; but are so far from seeming to proceed from one Parent only, that they evidently demonstrate Marks of the Female as well as the Male; which would not be, if the Parts of the Body were first perfectly delineated in either Sex.

Another great Objection is, the great and useless Abundance of these Animalculæ, in which only one, among so many Thousands, can come to Perfection. To which add, the Smalness of the Animalculæ, if compared to the Fœtus, and its Membranes, &c.

Every Thing being well considered, the Matter seems altogether obscure; or rather more Truth appears in Favour of that Opinion which defends a successive Formation of the Organs: A strong Argument for which is, the organical Changes made in the Parts of the greatest Consequence, which are very differently disposed in the incipient Fœtus, from what they are in one which is mature; more especially in the Heart, which, out of a single Canal, is apparently folded together into two Auricles, and two Ventricles; to which are afterwards added new Lungs, a new pulmonary Artery and Vein, with the first Rudiments of the Aorta and Vena Cava, laid so as to correspond with one another.

But Experiments on the Polype which are found in fresh Waters, Crabs, Earth Worms, and the falling off of the Horns of Harts, again repairable; with Instances of maimed Parts restored, in other Animals; all these demonstrate, that various
animal

animal Organs, even those sufficiently complex, and of considerable Use, may be repaired, without the Assistance of any previous Rudiments, or directing Out-lines. In Consequence of this weighty Argument is derived, from the organical Formation of Parts, out a mere Fluid, as we observed before, to be discernable in many Animals, where a gelatinous Humour is by Degrees hardened, or inspissated into Bones, Muscles, &c. We have somewhat analogous to this in Plants; in which the Wood, and all the Parts, are gradually formed, or built up, in an evident Manner, from a Fluid condensed within a cellular Fabric; whilst the same Power not only continues, but is likewise largely spread throughout every Branch of the whole Tree; insomuch, that every Twig can produce a Root, Branch, Leaf, Flower, and Fruit.

But it may be asked, Of what Use are the seminal Animalculæ? Whether they are the Rudiments of Fœtuses undetermined, and requiring many Changes, by the Increase of some Parts, and Evolution or shrinking of others, to bring it, at length, to the human Shape, by a successive Fabricature? Or whether there is any Truth at all in this Hypothesis? These Vermicles, which we see, being naturally bred in the Semen, as the like little Eel-like Animalculæ are bred in Vinegar, or other Infusions of Herbs.

But it will be demanded, if it be so, Why the same Animalculæ are not to be found in other Fluids of the human Body?

The most antient Opinion of Generation (which still prevails) is described in these Lines:

*The Male's and Female's Seed agree to make
The tender Young; of both the Young partake:*
But

*But yet that Sex the Young resembles most,
That hath more powerful Seed, more vigorous Lust.
If Mother's, Her's; if Father's, then the Male's:*

CREECH'S LUCRETIVS, Book iv. ad Fin.

Add to this, that when the male Semen is injected into the Fundus of the Uterus, which cannot be admitted but at the Time when the Woman evacuates her Fluid, or Semen, as some will have it, without that critical Moment, no Conception can ensue.

The feminal Fluid is retained in the Vesicles as long as a Lad neither exercises Venery, nor sports in imaginary Dreams: But it is always a Stimulus to the animal Appetite of Venery, as long as it is there present in any Quantity, which becomes considerably strong, the volatile and odorous Particles of it absorbed in the Blood, where it produces wonderful Changes, as soon as it begins to be formed; such as the Protrusion of the Blood, the Covering of the Pubes, a Change of the Voice and Passions, Horn in Cattle, &c. for these Changes in the Animal are not only the Consequences of Age, but of the feminal Fluid, which we plainly see is different in Eunuchs, who are deprived of this Liquor; and likewise in female Animals, when their Testes are absent. The Growth and Strength of the castrated Animal are constantly diminished; and, in like manner, the Fierceness of their Tempers, and the strong Smell of their whole Bodies, are remarkably weakened.

In the female Testes, or Ovarium, of ripe Years, they are extremely turgid, with a lymphatic Fluid, which will harden like the White of an Egg, and with which little Bladders are dis-

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tended: Also, before Conception, there is generally formed, by Degrees, a kind of yellow Coagulum, within some Vesicle of the Ovary; which Substance increasing very much, by Degrees, the Tunic of the Vesicle disappears, and changes into a hemispherical yellow Substance (commonly called *Corpus Luteum*) somewhat like a Bunch of Currants; which Substance is internally concave, and includes in its Cavity, as far as we can perceive, the very minute concave Membranes, or Eggs, which are to be the Seats of future Fœtuses*.

The Extremity of the Tube, therefore, surrounding and compressing the Ovarium in the fervent Congress, presses out and absorbs a mature Ovum, from a Fissure in the external Membrane; whence it is continued down, by the peristaltic Motion of the Tube, to the Uterus itself; which peristaltic Motion begins from the Apex of Contact with the Ovum, and urges the same downwards successively to the Aperture into the Fundus Uteri. This yellowish Substance is named *Corpora Lutea*, which is never absent in prolific Females, but always forms a Protuberance; from the repeated and constant Observation of the Number of Scars or Fissures in the Ovarium being always conformable to the Number of Fœtuses excluded by the Female†.

The *Corpora Lutea*, one would be apt to think, are the Females Semina: For how ridiculous is it to imagine that it is to coagulate the Orifice of

* This is the commonly received Opinion: But they appear to me to be *Vesiculæ Seminales*, the same as in Men, only not so large.

† It is amazing to me, that so many ingenious and learned Men will have it, that Women have Eggs, as Hens, Birds, Fishes, &c. to whom it is very necessary; as having no proper Matrices to nourish their Fœtuses; and for the greater Fertility of their Species; as we see in Fishes, &c. who spawn the Multitude of Eggs they expel.

the Uterus! Yet it never was observed, that the Ovum is included in the yellow Calix, in passing the Tube; nor how small an Ovum is (as it is commonly called) in the Tube: For it is not small enough to enter the Uterus, as this Passage is so narrow. And why may not the mucous Fluids coagulate the Semen Virile, and nourish it during the Embryo State?

It may be asked, Whether the Seat of Conception be in some certain Part of the Uterus, to which Experiments shew that the male Semen is conveyed; or whether the Energy of the male Semen impregnates the Ovum, while it is yet lodged in the Ovary; as would seem to follow, from Examples of Foetuses found in and about the Ovary, and in the Tube?

After Impregnation of the Uterus, its Cervix contracts; and for some Days after Conception has lain in the Matrix, the prolific Substance begins to send out, on all Sides, fleecy soft Branches from its including Membrane, which is, as yet, simple: These Fleeces inosculate and cohere with others of the same belonging to the flocculent, exhaling, and absorbing Vessels of the Uterus internally; this Adhesion of the Placenta or prolific Matter, is made in all Parts of the Matrix, but more especially in its thicker, which is the Fundus. By this Communication, a thin serous Humour passes from the villous Arteries of the Uterus, and absorbs into the inclosed Membrane, which is thereby sustained, together with the included Embryo; but before this Adhesion, it is either sustained by the Matter it already contains, or else by such Juices as it absorbs from the surrounding Humours.

At this Time, in the Ovum, or Sacculus, there is a Quantity of a limpid aqueous Liquor, which, like the White of an Egg, hardens by the Heat of Fire,

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Fire, or a Mixture with Alcohol; and now the invifible Embryo firft appears, with a very great Head, a fmall flender Body, and, as yet, without Extremities, fixed by very broad flat Navel Veffels to the obtufe End of its included Membrane: From hence the Embryo continually increafes, as well as its Appendages, but in a variable unequal Proportion: For while the arterial Serum is conveyed by more Paffages open into the fmall Veffels of the included Membrane, the Embryo itfelf grows the fafter; becaufe now the greater Part of what it fufains feems to pafs through the ample and open umbilical Vein. At the fame Time the Placenta grows alfo, but lefs in Proportion; and the aqueous Liquors, which it includes, gradually diminifh from their firft Proportion, in refpect to the Bulk of the Fœtus. The fleecy Productions of the Veffels from the included Membrane are gradually fpread over with a continued Membrane, which makes the Chorion, between which and the Amnios they are intercepted: Of thefe, the greater Part difappears below, or elfe terminates in the Chorion; and only thofe which fpreut out from the obtufe End of the Sacculus take Root, and increafe fo as to form a round Circumference named Placenta Uterina.

Such is the Appearance of the Rife of Conception commonly in the fecond Month; whence, afterwards, it changes only by increafing in Bulk. That Part of the Sacculus next to the Fundus of the Matrix is commonly fuperiorly, making about a third Part of its whole Surface, in Form of a flat round Difh; fucculent, and full of Protuberances, but throughout perfectly vafcular, uniting, and interwoven with other Tubercles of the fame kind, and with a thin cellular Fabric of the Uterus, accurately collects and connects the fmall Veffels of the Uterus, as exhaling Arteries, fo as to

correspond inseparably with the inhaling or absorbing Veins of the Placenta; and the wide-opening Veins of this last to the Veins of the Uterus. This Communication of the Vessels appears evident from the Loss of Blood which flows from the Separation of the Placenta in a Miscarriage; and from the Blood of the Fœtus being exhausted from an Hæmorrhage in the Mother; which ensue from the umbilical Vessels, so as to kill the Mother when the Placenta has been left adhering to the Uterus; and, lastly, by Injection of Quicksilver into the uterine Arteries which pass into the Vessels of the Placenta. Add to this, the Cessation of the Menstrues, which Blood is absorbed by the Fœtus.

The remaining unconnected Portion of the Sacculus Membrane, and likewise the Surface of the Placenta, are covered by an external villous and fleecy Membrane, full of Pores and capillary Vessels of a reticular Texture, which easily lacerate, so as to resemble a fine Placenta, and is named Chorion: But even this is, in some measure, connected to the Surface of the Uterus by very small fleecy Vessels, but less, and softer, than the Vessels of the Placenta; but then these have internally a true solid Membrane spread under them as a Foundation, which may be either called the internal Lamella of the Chorion, or a second distinct Membrane of the Fœtus.

FALSE CONCEPTIONS AND MOLES.

Some of the Antients thought, that if the Parts of the Embryo and Secundines were not distinctly formed from the Mixture of the male and female Semen, they rise to a Mass, which, evacuated before the fourth Month, was named by them False Conception; or if continued longer in the Ma-

trix, so as to increase, they termed it Mola; and others imagined that it was produced from the menstrual Blood retained in the Uterus.

To illustrate this Opinion, they quoted Examples of virtuous Widows, who (they say) were delivered of Moles a long Time after the Death of their Husbands.

But we are not so credulous now-a-days; therefore we affirm, that all Moles are real Conceptions, and cannot happen unless there has been some venereal Intercourse between the two Sexes.

The Moderns have advanced two Hypotheses to explain false Conceptions and Moles. The first is, that a Mole is a true Conception in its Origin, and has afterwards perished: Some, sooner or later, that the including Membrane and Placenta were left adhering to the Uterus, as in the State of a Foetus which receives its Nourishment when alive. Whence sometimes it grows as large as a Foetus, but in a deformed Mass. The other is, that the Mole is a Vesicula, or Ovum, which was fecundated by a feminal Animalcula, but has adhered to the Uterus, and increased without an Embryo.

To corroborate this Opinion, they cite Examples of Moles wherein no Rudiments of Embryos could be discerned; whence they concluded, that an Animalcula had never entered it. But it is my humble Opinion, that if the Woman has never conceived, she never had a Mole, as it is commonly termed.

As to those Moles wherein no Vestigia of an Embryo are not discernable; it is only owing to the early perishing of the Embryo; otherwise it would appear visible in Proportion to the Time it has lived in the Uterus.

To have an Idea of a decayed Embryo in a Mole, we may compare it to the withered Kernel of an Almond; in which the Shell is like the

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Membrane and the Placenta which incloses the Embryo or Fœtus.

The Causes of false Conceptions and Moles, or, more properly speaking, Miscarriage of Conception, are; 1. The Embryo or Fœtus may be destroyed by a Dropsy, Inflammation, &c. whence its Body becomes so dry and corrugated, that it will be almost imperceptible; especially if that happens very early. Or the Embryo may die from a Misconformation of the Organisation of its Oeconomy or Appendages, or else want of receiving Nutrition, &c. In fine, a Defect in the Fœtus, or its annexed Parts, may cause the Destruction; which, as it happens sooner or later, will make the Embryo or Fœtus more or less conspicuous, so as sometimes to distinguish what Sex it is; whilst at other Times we cannot see even a Vestigia.

As for the other Hypothesis, that no seminal Animalcula has entered the Vesicula or Ovum, or because they perished in the Uterus before the Ovum descends from the Ovarium, or be not dextrous enough to enter into the Ovum!

I, for my Part, think this Hypothesis perishes itself, as well as the Embryo, when Generation miscarriages.

A Mole, or Misconception, is of different Sizes and Substances, according to the Time it has remained in the Uterus. Some are pulpous, soft, and spongy; others membranous, &c. They have a Cavity, more or less large, in their Middle; this is sometimes full of Serosity, or Hydatides, as large as a Pigeon's Egg, &c.

It adheres to the Uterus like the Placenta, but has no Funis continued to it; its Formation is generally attended with the same Symptoms as a true Pregnancy, but the Continuance in the Matrix is very uncertain; for sometimes it comes away like
Abortion,

Abortion, in about two, three, or four Months, with the same Evacuation of Blood, and commonly more violent; or it remains sometimes for several Years, and becomes scirrhus, which communicates to the Uterus.

It is impossible to distinguish a false Conception from a true one for the first four or five Months: However, we may suspect a Mole in the Uterus, when, upon any Motion, the Woman feels a Load or Weight like a Ball of Lead; when her Belly is round, and she has not felt any Agitation in her Womb during the Time she thought herself with Child.

Women are most subject to Moles when their Menfes begin to leave them, and sometimes soon after they are married. Commonly this Misconception comes away, before the End of nine Months, like an Abortion; sometimes without Pains, but generally with a Flux of Blood.

The great Difficulty of Delivery is, when the Mole is very large, such as some Authors have met with, as large as a full-grown Fœtus, nay bigger, as they relate; and there is no Motion or Contraction excited in the Uterus, as when there is a real Fœtus: For a Mole affords no Opportunity of being extracted. Whence several Women have died of it, when the Moles were large, and adhered closely to the internal Surface of the Uterus.

After the Exclusion of a Mole or Abortion, Examination should be made to know whether it is a Mole, or Abortion. In the former, the Membranes are almost obliterated, and the Placenta makes more than one Half of the Volume; whilst, in abortive Labours, it takes up no more than one Third of the Mass. The Cavity in the Center is considerably diminished, and much less in Proportion to the Size of the Placenta: Moreover,

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when Abortions happen about the third or fourth Month, we always find the Embryo in a good State; but in the Case of a Mole, on the contrary, it is intirely corrugated.

In the Case of Abortion, the separating of the Placenta from the Uterus may be occasioned, 1. By the Extravasation of Blood, Milk, &c. between the Placenta and the Uterus. This intermediate Liquor will cause the Separation. 2. If the Placenta be contracted, and corrugated, it will separate from the Uterus. 3. The Placenta may be disengaged by violent Shocks, &c. The former are of the greatest Consequence.

They are deduced; 1. From the Virus of the Blood. 2. From the Embryo. 3. From the Uterus; or, 4. The Mother.

The Blood may cause Abortion by a too great or small Quantity; which two Causes are directly opposite to each other. Tho' the Fœtus requires a moderate Quantity of Blood, yet too much may create an inflammatory Infarction, or stop the Circulation, and so destroy the Fœtus; or the Plethora, which may lacerate the Vessels; violent Hæmorrhages, and an Inundation of the uterine Vessels; whereby the Placenta is separated; and, consequently, the Fœtus dies for Want of Nutrition. The longer it remains in the Uterus, the longer the Hæmorrhage continues; because the lacerated Vessels are kept dilated, which, in this Case, perform the Thing as a Ligature round the Arm in Venesection. Therefore the Fœtus should be extracted as soon as possible; otherwise the Mother and Child will perish.

2. An Abortion may happen from a Defect in the Fœtus, if the Circulation of the Blood be interrupted by any Obstacle, or if the Fœtus is too large and heavy, or dropfical; for the Weight and
Motion

Motion break the Adhesion of the Placenta from the Uterus.

3. The Uterus will give Room for Abortion, if it be too small, and cannot yield, or be sufficiently dilated by the increasing Fœtus and Placenta; or if it be not sufficiently pulpos, so as to receive the Placenta to adhere fixed, and not to yield to the least Effort of the great Quantity of Serum which bathes it. In the above Cases an Abortion is unavoidable.

4. By the Mother's Means; which may happen from violent Fevers, Vomings, Tenesmus, Convulsions, &c. all which, by the Shocks they excite in the Body, frequently Cause an Abortion.

In regard to external Causes of Abortion, they are, strong Purgatives and Emmenagogues, which over-rarefy the Blood, and produce Hæmorrhages, sudden Passions, or Frights, Sorrow, &c. or violent Motions; as leaping, dancing, riding in jolting Carriages, raising too great Weights, Falls or Strokes on the Region of the Matrix, habitual Fluxes, immoderate Evacuations, &c. all these contribute to produce an Abortion in several Women; particularly, when the Union of the Placenta with the Uterus is not very firm.

We may observe, that there are several other Methods and Means of procuring Abortion. For how many abdominal Remedies do those miserable Women, who covet Abortion, make Use of, as Ministers to put their wicked Designs in Execution!

Though Miscarriages, in general, are dangerous; yet the Danger is not equally great in all its Cases: It varies, principally, according to the Time in which it happens; the Degree of the Symptoms, &c. for Abortion in the second or third Month, is less dangerous than when it happens in the fifth or sixth: Because, in the last

Case, the Fœtus is larger, and the Adhesion of the Placenta firmer; both which must be overcome before the Exclusion of the Fœtus: So that Abortion is reckoned more dangerous than a natural Birth; especially when it is violent, or suddenly procured. For, in that Case, the Placenta is so distracted from the Uterus, that some of it frequently remains attached to that Organ; or, what is worse, it brings along with it some of the very Substance of the Uterus, or bursts some of the collateral Vessels; whence arise mortal Hæmorrhages, Ulcers, &c.

Several Instances of this Kind we read of in Authors of Veracity; and now and then they are met with in Practice.

The interior Membrane of the Fœtus, called Amnios, is of an aqueous pellucid Texture, very rarely spread with any conspicuous Vessels (which has not yet appeared very distinct in human Subjects), extremely smooth, in all Parts alike, and extended under the Placenta with the former, the Surface of which is every Way in Contact with the Waters with which the external Lamina of the Chorion and the cellular Substance is connected.

The Urachus, it is said, has been found in some human Fœtuses perforated*.

MONRO (in the Medical Essays, Vol. II.) thought he saw the Allantois Membrane in our Species; but I think it is nothing but the cellulous Membrane between the Chorion and Amnios which connects them.

There is a Membrane placed between the Chorion and Amnios which covers the smooth Surface

* Vid. Memoires de la Royal Acad. des Sciences 1701.

LITRE has given us Instances of this in two Children. He also says, that he found the Allantoid or urinary Membrane in the same Subjects, which made him suspect that this Membrane is likewise in our Species, as well as in Quadrupedes. He gives us also Observations of two Men whose Cervices of their Bladders, being obstructed, discharged the Urine by the Navel.

of the Placenta, and furnishes Vaginæ to the umbilical Vessels*.

OBSERVATIONS.

LITTRE has presented to the Academy of Sciences † a fecundated Egg (as he called it), which was inclosed in the Ovary. It was observable, that the small Embryo was a Line and a Half thick, and about three Lines long, and floated in a clear mucilaginous Liquor.

He says, that he has observed, without a Microscope, the umbilical Vessels which inclose the Embryo.

Several Authors relate Histories of Fœtuses falling into the Abdomen, without any Laceration of the Uterus, or the Tubes.

COURTIAL says‡, that he saw a Fœtus, in the Abdomen, with its umbilical Vessels round the Neck; and whose Placenta, which was situated under the Stomach, communicated with the Gastro-epiploic Vessels.

LITTRE says||, that he found a Fœtus in the Fallopian Tubes.

DIONIS mentions two Instances of this Sort: The first of a Woman of Tholouse, in whose Abdomen was found a Fœtus included in a shapeless Mass, in which it was thought to have been twenty-five Years. This Fœtus weighed eight Pounds.

* See ROHAULT's Memoirs of the Royal Academy of Sciences 1714, 1716, 1718. Also HOBOKENUS De Anat. Secund. Human. DIEMERBROECK's Anat. Lib. I. and NEEDHAM. Observat. Anat.

† Vid. Memoires de la Royal Acad. des Sciences 1701:

‡ See his Observ. Anat. Also THO. BARTHOLIN. Hist. Anatom. Cent. vi. Miscel. Medico-Physic. Observ. cx.

|| Vid. Memoires de l'Acad. Royal des Sciences 1702. also RIGLAN. Anthropograph. Lib. II. and Act. Erud. Leipf. 1701.

The other, which he was an Eye-witness of, was a Fœtus about five or six Months old, found in the Abdomen; and had, during that Time, remained in a Bag, which was connected to the Uterus, and appeared to be a Portion of; having a particular Tube, Ovary, Ligamentum Latum, and Rotundum; but, being carefully examined, it was found that its Cavity had no Communication with the Uterus, but was only united to it by some Vessels covered with Membranes. This Bag bursting, left the Fœtus to drop down into the Abdomen, and the Woman died. See DIONIS's Anatomy.

We meet with another Case of a Woman about thirty Years of Age, who evacuated by Stool several Bones of a Fœtus about six Years old.

LITTRE, who had the Care of the Patient, finding that the Uterus was in its natural State, and being informed that nothing was brought from it during Gestation; thrust his Finger into the Rectum, the Side of which he found perforated about an Inch and a Half in Extent, and through which he felt the Bones of the Head of the Fœtus, which he laid hold of with his cutting Forceps: By this means he extracted them, and the Woman was perfectly recovered.

He well observes, that the Fœtus had been included in a Bag about three Lines thick, from the Fragments which came away with the Bones*.

All these Observations are not weighty enough to prove that our Species arise from an Ovum. As to those Fœtuses found in the Fallopian Tubes, they are nothing else but thro' a Dilatation of the Uterus after Conception, as other Parts of the Vis-

* Vid. Memoires de l'Acad. des Sciences 1702. Somewhat like it is also to be met with in AMIAND's Observations on Deliveries. See likewise BARTHOLIN. De Infantibus Partus Humani.

cera do in some Diseases: So that if the Placenta does not adhere to some Part of the Matrix, then the Circulation ceases, and the Fœtus immediately dies. Or if the Uterus happens to dilate, and afterwards lacerates where its Sinuses communicate with the Vessels of the Placenta, the Mother dies immediately.

Some Authors relate, that they have found Fœtuses which have burst the Matrices by their violent Gestation.

Those who are desirous of having more Cases concerning Fœtuses found in the Fallopian Tubes, and Cavity of the Abdomen, may peruse the following Authors; viz MAGNET. *Theatr. Anat. Tom. II. & Bibl. Chirurg. Tom. II.* ANELLUS's *Dissertation sur la Generation de l'Homme.* VIEUSSENS *Dissert. de Struct. & Ufu Uteri.* STRAUSS *Histor. Fœtus.* BAYLE *Hist. Anatom. Gravid.* ELHOLTZIUS *de Conceptu Tubario.* BUSSIÈRE. *Philosophical Transactions for the Year 1694.* DU VERNEY *Epist. de Fœtu.* CYPRIANUS *Observat. Anatom.* BIANCHUS *Theatr. Anatom.* and an extraordinary Case in SANTORINI *Disc. de la Generat.*

VALLISNERI has wrote very ingeniously on Generation in Italian.



LECTURE XVIII.

Of the FOETUS IN UTERO, its Accretion, Nutrition, &c.



AFTER Conception, the Embryo increases gradually. The Encephalon, or Head, and its Appendages, are first formed, and completed; then the Viscera of the Thorax, and afterwards those of the Abdomen, with its Contents; and, lastly, its Extremities sprout out of its Trunk like Tubercles: Thus the wonderful Anthropogenesis of the Mechanism of the human Fabricature are formed.

Perhaps it may be asked, By what Cause the Parts of our Species are thus successively constructed? Whether this be the Employment of the Anima, or Mind? We answer, That this does not seem an adequate Cause; she being both ignorant of herself, and incapable to judge of Nature's Ends or Purposes, for which the several Organs, and their Actions, are to be employed, by a just Mechanism of the several Members in the Fœtus.

Or it will be questioned, Whether the first Rudiments, or Filaments, being contained either in the Ovum, or in the male Semen, are only afterwards displayed, and fitted out, by more plentiful flowing Juices? For this, we have neither
any

any Delineation demonstrable in the Ovum, as it is called, nor in the male Semen? Or whether, in Consequence of the Power of Attraction, by which Nature performs all her other Operations, the viscid Liquor of the Female altered, or that of the male Semen, does not first run together into a Filament, which, under unknown Circumstances, increases to a Web of Fibres, those into Membranes, Membranes into Vessels, and these again into Muscles; which, at length, condense into Bones, and all the Parts of the Body? We must give it as our Opinion, that this seems to be the most probable.

But we shall also demand, What can be the Intent of the wise Director of such a constant, curious, and so exact an Edifice, in so great a Variety of Parts, and to such a Number of particular Uses?

We answer, That it is, doubtless, the same ever-acting and permanent Laws of the wise Creator, by whom freezing Spicula, Crystal of Salts, the Particles of mineral Ores, the terrestrial Globules of Stones, and the sandy Glebes of Gems or Crystals, are so elegantly or geometrically constructed; by which the fine Dust of Mosses, and Filaments of Flax or Cotton, or the Jelly of fungous Tribes, with the different Juices of Plants and their Appendages, are so variously modulated. The same Power, under various Circumstances, certainly ordains the unorganised Parts of suitable Matter into the tubular Webs and Fibres of Vegetables, the Glue of the more simple Insect and Shell Animals, the terrestrial Stamina of the Blood and finer Juices of the more perfect Animals, into such various Filaments, cellular Webs, and vascular Membranes, &c. as can be only the Effect of definite Laws, operating on the same kind of suitable Matter,
and

and under a Variety of Circumstances or Conditions perfectly similar.

Need we go farther for a Proof of this, than the successive Germination of the Viscera and Extremities in a Fœtus; in which, as in the Polype, we see superior and inferior Extremities rise insensibly, not as Filaments, but equally, from Tubercles, which (like Trees) grow, in Length, in Proportion as they increase in Thickness, and are unequally dilated?

Consider, if the successive Formation of the Heart, out of a single Tube, in a Fœtus or Chick, afterwards curiously complicated, and then, by Degrees, shielded within a Craticle of the Ribs, &c. Will not this be enough to turn the Balance of our present Inquiry? especially if we consider well the Series of Growth in Plants, Polypes, Insects, Chickens, the feathered Tribe, and in Fœtuses of our own Species, leisurely composed together?

From the Conception of the Embryo till the State of the Fœtus, it is probable, that it receives Nutrition from a kind of oozing Liquor, in which it swims, through the Pores of its Substance. For we are to consider Conception thus: First, The Membranes in which the prolific Matter is contained, and which is preserved in Form of a Vesicle; it is very probable, also, that the Placenta is at first only formed of the small Vessels which fixed the conceptive Matter in the Uterus, where the Fœtus is formed, and nourished by the umbilical Vessels. Lastly, By the Mouth also, as some Authors will have it; when the Mouth, Oesophagus, Stomach, &c. are formed with the Liquor in which it swims.

The uterine Vessels deposit the nutritive Juices through the umbilical Vein, which arise from the Roots of the exhaling uterine Vessels, which have

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a manifest Communication with some Roots of the umbilical Artery, from whence it partly rises; and, uniting in a larger Trunk, it is twisted, in a circular Manner, through a Number of Circumvolutions, to a sufficient Length, that may allow of a free Motion; and in its Course it is surrounded with a cellular Substance full of Mucus, distinguished by three Partitions, and the Membrane, which is continued both to the Amnios and Peritonæum of the Fœtus; and, after forming some Protuberances, it enters through the Navel in an Arch made by a parting of the Skin and abdominal Muscles, and goes on through the proper Sinus of the Liver, into which the smaller Portion of the Blood that it conveys is poured through the slender Ductus Venosus into the Vena Cava, situated in the posterior hypatic Fossa; but the greater Portion of the Blood goes through the large hepatic Branches, which constantly rise from its Sulcus, and remains even in Adults; but from thence it goes to the Heart by the continuous Branches of the Vena Cava.

It may be asked, Whether the Circulation be reversed in the Liver of the Fœtus? Whether the Sinus or left Branch of the Vena Portarum be not a Part of the umbilical Vein itself, so as to convey the Blood, by its Branches, from the Cava, whilst only the right Branch conveys the Blood of the Mesentery and Spleen through the Liver? and Whether this Motion is allowable from the different and almost contrary Direction of the Blood from the umbilical Vein, and that brought from the Mesentery; since there is no Septum to distinguish between the umbilical Vein?

The Blood of the Vena Cava passes to the Auricle of the Heart through the Foramen Ovale: The Blood which has entered the right Ventricle, being forced out of it by its Contraction, passes through

through the pulmonary Artery which corresponds to that Ventricle, and there the Blood is divided, that is, one Portion of it passes into the Aorta Inferior, by means of the arterial Canal, whilst the other Portion, which is less considerable, goes to the Lungs.

The Portion of Blood which we observe passes into the left Auricle by means of the Foramen Ovale, mixes in that Auricle with the Portion of Blood which returns from the Lungs, the pulmonary Vein, and these Portions of Blood afterwards pass into the left Ventricle, which, by its Contraction, forces them to enter into the Aorta, and to flow through its different Ramifications. According to this Description, the Valve of the Foramen Ovale hinders the Blood from passing the left into the right Auricle.

MERY* maintains the contrary to what we advance here. He thinks, that the Blood passes in as great a Quantity to the Lungs, as if the Fœtus respired. He founds this Opinion on the considerable Diameter of the pulmonary Artery of the Fœtus, and thinks, that the Blood which returns into the left Auricle, enters partly into the Ventricle on the same Side, whilst the other Portion passes through the Foramen Ovale to discharge itself into the right Auricle.

WINSLOW considers the two Auricles of the Fœtus's Heart as only forming one with respect to the Foramen Ovale, and the two Ventricles as one with regard to the arterial Canal; and, lastly, the Lungs of the Fœtus with respect to the Circulation of the Blood, as another Organ whose Use is unknown. This being granted, it appears reasonable to him, to think that the Blood, which re-

* Memoires de l'Acad. Royal des Sciences 1699 & 1701.

turns by the Vena Cava into the right Auricle, without any Impetuosity, meets with that which returns from the Lungs in the left Auricle; that they mix in the Diastole of the Auricles, and by that means they become an uniform Fluid, and equally impregnated with that from the Placenta, so to be propelled through the two Ventricles as through one, and to be equally distributed through the pulmonary Artery, the arterial Canal, and the Aorta, as through one single arterial Trunk, to all the Parts in general.

He ascribes no other Use to the Valve of the Foramen Ovale, than to form an intire Partition, after Birth, between the two Auricles which close up the Passage of the one to the other.

At the Beginning of the Vena Cava Inferior, we find a Valve, called, from its Discoverer, Eustachin. It is commonly membranous, and sometimes of a reticular Texture: Its Figure is nearly that of a Crescent; the convex Margin is turned inferiorly, and adheres internally to the anterior Sides of the Vena Cava Inferior; and of the two Horns of the Crescent, one terminates anteriorly in the Margin of the Foramen Ovale next to the Parts of the Auricle; and the other adheres to the posterior Margin of the same Foramen, and also to that Part next to the Auricle; so that, being arched or separated from the Sides of the Vena Cava, it is applied over the Partition of the Auricle near the Basis of the Heart. As this Valve is generally more extended in Proportion in a Fœtus, than in Adults; WINSLOW* thinks, that it prevents the Blood of the Auricles from regurgitating into the Vena Cava Inferior; whence it

* Vid. Memoires de l'Acad. des Sciences, 1717, & 1725. Ibid. 1708. See TAUVRY's Treatise on the Fœtus.

might also regurgitate into the umbilical Vein, if it would not hinder Respiration in the Fœtus. Whilst included in its Membranes in the Uterus, it was necessary that it should receive a nutritious Fluid and Blood which have been impregnated with Air.

It is evident, that this Quantity of Fluid, continually furnished by the umbilical Vein, would unavoidably overload the Fœtus, if the superfluous was not returned into the placentine Arteries.

The Placenta was called by the Antients, from the Likeness it bears to the Liver, *Hepar Uterinum*.

The Number of Placentæ in human Subjects answers to that of the Fœtuses : As these are usually single, the Placenta is likewise so : When there are two or more Fœtuses, there are always as many Placentæ ; but, in this Case, they often cohere one to another, so as to seem but one Substance : But, even in this Case, their Vessels do not communicate with each other.

In Quadrupeds, particularly Cows, there are often a great Number of Placentæ, sometimes not less than a Hundred, to one Fœtus. In this Case, they are called *Cotylidones*. The Figure of the Placenta is somewhat orbicular ; its Diameter is eight or nine Inches, and its Thickness about an Inch. Its convex and spongy Surface is connected to the Uterus by means of a very thin Membrane, which is reticular, villous, and continuous with the Chorion ; its concave Surface is turned towards the Fœtus, connected to the Funiculus, and surrounded with a smooth Membrane from the Chorion and Amnios. It has no fixed or certain Part in the Uterus to adhere to ; but is usually fixed to the Fundus.

The greatest Part of the Blood is returned from the Fœtus to the Placenta by two large Arteries,

which generally rise from the Iliac on each Side, sometimes from the inferior Portion of the Aorta, which are continued on in the Direction of the Aorta; and, after giving some slender Ramifications to the Femorals, with still smaller Arteries into the Pelvis, they ascend reflected back with the Bladder on each Side of it, surrounded with the cellular Lamina of the Peritonæum, with some Fibres spreading to them from the Bladder and Ureter; in which passing alternately, in a streight and contorted Course, they form various Twistings or Windings, somewhat sharper than those of the Vein which they accompany; in which Manner they at last arrive at the Placenta, whose Substance is formed of their Branches, in Conjunction with those of their corresponding Vein. By these Branches, the Blood seems to pass out through minute Arteries of the Placenta, into the bibulous Veins of the maternal Uterus, that, after undergoing the Action of the Lungs by the Mother's Respiration, it may return again, in an improved State, to the Fœtus: For what other Reason can be assigned for such large Arteries, which carry off above a third Part of the Blood in the Fœtus to the Placenta and Matrix?

Most Anatomists will have the Placenta of a glandulous Substance. They affirm, that it is composed of a Multitude of minute Glands; but have not been able to demonstrate them.

We may be convinced that the Placenta is nothing else but a Congeries of Vessels, by macerating with proper Care. I have prepared some, which I keep by me, wherein the minute Extremities of the Arteries and Veins are distorted and injected.

There are two Opinions concerning the Ramification of the umbilical Arteries: Some think, that these Vessels form Anastomoses with the Ramification

mification of the umbilical Vein; others pretend, that they do not terminate in the Placenta; but, having passed through it, lose themselves in the spongy Substance of the Uterus, there discharging the Blood which they bring to the Fœtus; which being resorbed by the uterine Veins, by which means they, endeavouring to establish a Circulation between the Child and Mother, as the umbilical Vein with that of the Mother.

The other Opinion, which is inconsistent with Experiments, is, that the Mother furnishes no Blood to the Fœtus, but only a lacteal Juice; which, according to them, is secreted by the uterine Glands, which, they also say, are to be found on the internal Surface of the Uterus, and which is resorbed by the Ramifications of the umbilical Vein.

They affirm, that there is a Communication between the Fœtus and the Mother, which they are supposed to have proved.

As for the Glands of the Uterus, MERY, and several other Anatomists, deny their Existence; and, to prove that the Mother really furnishes Blood to the Fœtus, and not simply a lacteal Juice, they say, that, after Expulsion of the Fœtus, if we cut the Funis Umbilicalis without a Ligature, and the Placenta adhering to the Uterus, the Blood of the Mother flows from the umbilical Vein.

Does not this seem an incontestable Proof that the Blood of the Mother passes to the Fœtus thro' the umbilical Vein? For it cannot be supposed that the umbilical Arteries can convey the Blood of the Fœtus to the Placenta when the umbilical Vessels are cut off; nor can it reasonably be supposed, that the Placenta furnishes all the Blood discharged from those Women in whom no Ligature has been made on the Portion of the umbilical Vessels

Vessels adhering to the Placenta, since we can hardly have a Porringer full of Blood from it, when separated from the Matrix.

We are to observe, with respect to this second Opinion, concerning the reciprocal Circulation between the Mother and the Fœtus, that the Arteries of the Mother communicate with the umbilical Vein, and the umbilical Arteries of the Fœtus with the Veins of the Mother. We are not to imagine that these Communications are immediate, that is, these Vessels are united to each other, but only that the Arteries of the Mother open into Cellules or Pores of the Placenta, in which the Orifices of the umbilical Vessels absorb the Blood, afterwards to transmit it to the Trunk of that Vein, and the umbilical Arteries open into the Pores of the Uterus, where the Orifices of the Ramifications of the uterine Veins receive that which these Arteries carry thither, to exonerate it afterwards to the Trunk of the Hypogastrics.

Wherefore we ought not to be surpris'd, if, during Gestation, the Placenta is separated, either in whole, or in part; and should happen Hæmorrhages, and subsist till the Woman is delivered of the Fœtus and Placenta, which permits the Uterus to contract its Orifices which correspond to those of the Placenta.

In this Case, we ought to use all Means to deliver the Woman, in whatever Period of Pregnancy she happens to be.

The Adhesion of the Placenta to the Matrix is not fixed by the immediate Union of the uterine Vessels with those of the Fœtus; for it only seems to depend chiefly on the Inequalities of the Surface of the Uterus, and those of the Placenta, received reciprocally into the small Cavities found

between these Eminencies, from which they are obliged to depart when the Uterus contracts.

It is commonly thought, that the Fœtus is nourished only by the lacteal Fluid of the Matrix, which the placentine Veins receive and convey from the umbilical Vessel to the Fœtus. Till the Organs of Digestion are sufficiently strong for their Functions, it also receives Nutrition by the Mouth. It remains a Question, Whether it does not swallow up the lymphatic Liquor contained in the Cavity of the Amnios, in which it seems to swim, and which is of a coagulable Nature, like the nutritious Serum? According to this Opinion, there seems to be some Analogy between it and the White of an Egg, in which Chickens are nourished whilst in the Shell; which is certainly so, as they have no umbilical Vessels. But how the Circulation is performed in them, has not yet been well explained, I think.

For should Fœtuses open their Mouths, they would certainly be in Danger of being suffocated by the Loquor Amnii.

We find, also, in the Uterus of the Fœtus, a Mucus, somewhat like that in the Stomach, &c. Shall we say that this Mucus arises from the Amnios Fluid?

But I think we may safely conclude, with DE LA COURVEC, DE NUTRITIONE FOETUS IN UTERO PARADOXA.

PETIT endeavours to prove, that the Fœtus can suck and swallow the Liquor, without the Assistance of Respiration. He has read a Memoir to the Royal Academy of Sciences at Paris; wherein he compares the Mouth of a Fœtus to a Pump, and the Tongue to its Sucker.

HEISTER has made Experiments on the Fœtus taken from a Cow involved in its Membranes, with the

the Liquor called Amnia, which was frozen about it: The same was found also in the Mouth, Oesophagus, and Stomach, of a Calf. Whence he concluded, that the human Fœtus receives Nutriment by the Mouth also.

This Experiment of HEISTER to me appears nothing at all probable. The Cow was dead before the Fœtus was taken out of her Belly; and probably, in dying, the Fœtus opened its Mouth, and swallowed that Liquor found in it.

I am of Opinion, that the Fœtuses do not open their Mouths, or Eyes, whilst in the Uterus; but that they are in a contracted State: Besides, we have Examples of human Fœtuses found born with their Mouths and Noses unperforated; also of Puppies just littered, which have been shewn to the Royal Academy of Sciences at Paris, with their Mouths so: Therefore they could not have received Nourishment by them.

Perhaps I shall be asked, What is that Mucus commonly found in the Oesophagus, Stomach, &c. of Fœtuses?

I answer, Nothing else but a Secretion from the glandulous Membranes of those Parts; which thus secreted, in Process of Time the thickest Portion forms what is called the Meconium, which is constantly found in the Intestines.

As to what FRED. HOFFMAN relates*, of a Child, born at its full Time, whose Funiculus Umbilicalis was entirely corrupted, and the Child perfectly well; he and PETIT account for it from the twisting of the umbilical Vessels, which these Authors suppose the Child to have remained some Time so in the Matrix.

* Vid. Aët. Nat. Curios. Dec. 2. Ann. 7. Observ. CCIX. STEP. VANDER WIEL. Observ. Cent. II. Journal des Savans, Ann. 1687, &c.

I do not suspect the Relations of these Authors ; But the State of the Fœtus in Utero, with respect to the Circulation of the Blood between it and the Placenta, if not the Matrix also ; appears, to me, entirely inconsistent with the known Laws of the Animal Oeconomy.

It is proper I should observe here, that the Liquor we find the Fœtus contained in, when young, and that which is evacuated at the Time of Delivery, is very different ; for the latter is aqueous, and not ferous, as at the Beginning of the Formation of the Fœtus.

In this Observation I am inclined to think, that Authors have not considered the Difference : For this aqueous Liquor may arise from the placentine exhaling Vessels, perhaps the Fœtus itself, and not be of the same Nature ; which we find in Abortion.

The ingenious HALLER *, after others, observes, that all the excremental Fæces, which are collected in the Intestines of the Fœtus, which is a dark greenish Pulp, may, possibly, be the Remains of the Bile, and other exhaling Juices.

And the same Author also questions whether the Fœtus has not an Allantoïd ; since it is certain, that there passes out from the Top of its Bladder a Duct, which is at first broad, covered by the longitudinal Fibres of the Bladder, as with a Capsule ; and afterwards, when those Fibres have departed from each other, they are continued thin, but concave, for a considerable Way over the umbilical Vessels, whence they have been traced by SWAMMERDAM †, Dr. HALE, and other eminent Anatomists, to the Expansion of the Placenta, under this Denomination ! Whether this, although it be not yet evident in the human Fœtuses, is not

* Vid. Physiolog.

† See Philosophical Transactions, N° 271.

confirmed by the Analogy of Brutes, which have both an Urachus, and an Allantois !

But as for any proper Receptacle, continuous with the concave Urachus, it either has not yet been observed with sufficient Certainty, or else the Experiment has not been often enough repeated to become general in the human Species : For we know, that, in the human Fœtus, the Urine is separated but in a very small Quantity. But it may perhaps be no improbable Conjecture, that some Portion of it is conveyed, by a certain latent Manner, into the Funiculus Umbilicalis, and there transfused into the spongy cellular Texture which surrounds the umbilical Vessels*.

The Circulation of the Blood is peculiar in the Fœtus : For in Adults, the Blood, on the contrary, flows from the left Sinus to that of the right Auricle of the Heart. This is evident, from all manner of Experiments and Observations. For, 1. The Column of Blood in the right Sinus, is, of all others, the largest : and as it is the returning one from the whole Body, it cannot be exceeded by any other : But the left Auricle has so much less Blood, in Proportion, than that of the right, inasmuch as Part of it flows through the

* SCHENKIUS says, that a Man, who had his Navel cut off by Accident, from that Time evacuated his Urine through that Place, in lieu of the Urethra. He also has observed in another Man, who by some Disorder was disabled from emptying his Bladder, that he had a Tumor formed round the Navel ; which breaking, he ever afterwards evacuated it through the Urachus.

THOMAS BARTHOLINE says, in his Anatomy, Lib. vii. Cap. xxxvii. that in Miscarriages, or new-born Infants, the Membrane of the Urachus is very obvious ; but I must own, that I never could perceive it.

I am of Opinion, that the Urine must be evacuated from the Bladder's Attraction ; as it is granted that the Fœtus does respire. Therefore the Diaphragm is inactive, and also the abdominal Muscles ; which, with the saline Particles of the Urine in Adults, and the Contraction of the Bladder, are the Means by which we make Water, which are entirely absent in the Fœtus.

Duct or Canalis Arteriosus into the Aorta, whence its Contents will be much less than that of the right Auricle: Besides, the Valve of the Foramen Ovale, in a mature Fœtus, is so large, and placed so much to the left of the muscular Isthmus or Arch, that, when it is impelled by the Blood from the left Side, the Valve, like a Shutter, closes up the Foramen; but, being impelled from the right Side, it readily gives way, so as easily to transmit it either into the Blood or Flatus.

There is but a small Portion of the same Blood which first entered the right Auricle and Ventricle of the Heart, that takes its Course through the Lungs: For the pulmonary Artery, being (in the Fœtus) much larger than the Aorta, is directly continued to the latter by an Aperture named the Ductus Arteriosus, which is larger than the Diameter of both the pulmonary Branches together, and enters that of the Aorta, which comes first in Contact with the Spine under its left subclavian Branch; by which means it transfers more than Half the Blood to the descending Aorta, which must otherwise have passed through the left Auricle and Ventricle into the ascending Branches of the Aorta: And this is the Reason why the Aorta (in the Fœtus) is so small at its coming out from the Heart.

By this Mechanism, an Overcharge of the Blood is turned off from the Lungs, by directing a great Portion of that Fluid in a strait Course to the umbilical Arteries.

Dr. CHEMINEAU has presented to the Royal Academy of Sciences of Paris, which he had repeated, concerning the Dispute, in those Days, about the Circulation of the Blood in the Fœtus between MERY and LITRE, which this Heart had three Ventricles; viz. the right Ventricle receives as commonly the Vena Cava, but without the pulmonary Vein; the left Ventricle receives

also the pulmonary Vein, but not the Aorta; and these two Vessels, the pulmonary Artery, and the Aorta, were implanted in the third supernumerary Ventricle.

The Apertures of these Vessels were so deposited, that the Blood of the right Ventriculus was expelled in the third, which takes its Course thro' the pulmonary Artery; and the Blood was also expelled in this Ventriculus by the left, and easily diffused itself into the Aorta.

There was no Ductus Arteriosus; the pulmonary Artery was very small in raising from the third Ventricle, and divides itself into two Branches, each of which had double the Diameter of that of its Trunk; which seemed to demonstrate, that the Blood comes out of the Heart to enter the Lungs, but so as not to be able to be admitted to remain; consequently these Branches dilated them so.

If the Infant had lived, the Circulation of the Blood would have been peculiar in him; for the third Ventricle would always have remained: As the Blood had not yet Admittance into the pulmonary Artery, as usual, it would have taken its old Course; therefore we should have seen a Man somewhat like an amphibious Animal*.

Some Authors relate, that they have found Fœtuses without Hearts; but I believe, that it is as rare, as what a certain Author tells us; viz. that he opened a Man, who was so emaciated, that the Heart was absent in the Pericardium†.

CHESELDEN observes, that a Portion of the Blood before Birth, and not the Whole, is brought by the ascending Cava to the right Auricle, passes at once through the Foramen Ovale into the left Ventricle with the Blood of the Descendens Cava,

* Vid. Histoire de l'Academie Royale des Sciences, l'Ann. 1699.

† Vid. TILESIIUS Rerum Naturalium, Lib. V. Cap. xxviii.

and thence into the pulmonary Artery, where about one Half flows into the Lungs, and the other Half directly into the Aorta by the Ductus Arteriosus, which lies between the pulmonary Artery.

He supposes, that the Quantity of Blood that flows through the ascending Cava, in a given Time, to be as four; and that which flows through the Descendens Cava, to be as two: Then let two of the Quantity in the ascending Cava flow into the right Auricle, and it will then, with the two received from the Descendens Cava, have the Quantity four; which being thrown from the right Ventricle into the pulmonary Artery, the Quantity two is thrown into the Aorta by the Ductus Arteriosus, and the same Quantity into the Lungs by the pulmonary Branches; then the Quantity returning from them to the left Auricle, in the same Time, will be two; which being added to the two which flowed through the Foramen Ovale in the same Time, there will be constantly the same Proportion received into each Ventricle, at every Diastole of the Ventricles, as after Birth.

Now if the Blood flowing through the ascending Cava, joined by that from the umbilical Vein, was but equal to that flowing through the Descendens Cava; let each of them be called two, and let all the Blood of the Ascendens Cava go through the Foramen Ovale; then the Blood that the left Ventricle should receive, would exceed that which flows into the right, by the whole Quantity that flows from the Lungs in the same Time: But the Ascendens Cava conveying more Blood than the Descendens, the Excess in the left Ventricle would be yet greater.

If the Proportions which CHESELDEN has taken, for Ease in Calculation, were perfectly right, and he seems sure that they are nearly so; then
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the Quantity of Blood flowing into the left Ventricle would be to that flowing into the right, in the same Time, as five to two, if all the ascending Blood went through the Foramen Ovale.

Though, after Birth, the left Ventricle of the Heart is only employed in throwing Blood into the Aorta, and the right wholly employed in circulating the Blood through the Lungs; yet, before Birth, all the Blood thrown out by the left Ventricle, and about Half the Blood thrown out of the right Ventricle, being thrown into the Aorta, and the other Part only through the Lungs; it follows, that the whole Force exerted by the left Ventricle, with about Half that of the right, is employed in throwing Blood into the Aorta, while that distributes Blood through the whole Fœtus, and to the Mother. But after the Birth, when the Blood is to be no longer carried from the Fœtus to the Mother, the left Ventricle becomes sufficient for the Circulation through the Fœtus, and a new Occasion immediately arises for that additional Power, which before was necessarily employed in throwing Blood into the Aorta; for the whole Mass of Blood now being to be circulated through the Lungs, the Ductus Arteriosus closes, and the right Ventricle must throw all the Blood it receives into the Lungs, there being no longer any Passage into the Aorta.

It is supposed, that the Inflation of the Lungs, at the Birth, presently alters the Condition of the Ductus Arteriosus, so as to obstruct it; which Account is indeed mechanical, but, I think, not true: Because I can neither discern that the Position of this Vessel is altered, nor its Surface compressed. But I rather think, that, immediately upon the Breath, there being no Blood carried off from the Fœtus to the Mother, and the left Ventricle being sufficient to fill the Aorta and its Branches with
Blood,

Blood, as I have shewn before; there is no longer Room for any Blood to pass from the right Ventricle; wherefore the Blood from the right Ventricle will be forced into the Lungs, where the Passage is now made easy, as I imagine, by their being inflated; and the Ductus Arteriosus, having the Blood no longer forced into it, shrinks, and, in Time, almost disappears. This Duct being stopped, the Valve of the Foramen Ovale soon stops that Passage, it being on the Side of the left Auricle (or that muscular Bag which is the largest Part of the Auricle), which being much the strongest, the Valve must be pressed more on that Side than the other by the Blood, in the Time of the Systole of the Auricle: And it is evident, that, in the Diastole of the Auricle, there must be more Pressure to open that than the right, it being a stronger Muscle; or else there could have been no Reason for having the left Auricle stronger than the right, in Proportion to their Ventricles.

Sometimes this Valve does not quite cover the Foramen; in which Case, a small Quantity of Blood may possibly flow from the left Auricle to the right, and so circulate twice through the Lungs to once through the Body; but none could flow from the right to the left, and escape the Lungs, which might be of bad Consequence.

Some have imagined that Men, who have this Passage open, cannot be drowned. But, though this Passage be sometimes found open, no Man has been yet seen, that we have ever heard of, that could not be drowned.

I have seen the Foramen open in a Man that was hanged, to whom one might justly expect it should have been as useful as in the Case of Submersion in Water.

Many have supposed, that this Foramen is open in amphibious Animals, and in such Fishes as have

two Auricles, two Ventricles, and Lungs like Animals, without Gills, which, in other Fish, are analogous to Lungs.

I have dissected a Porpus, which is of this Kind, and found this Foramen closed; but the great Veins were vastly large, in Proportion to the Bulk of the Animal: Whence I conjectured, that the Blood was accumulated in their Veins while they kept under Water; and, by that means, the Lungs escaped being oppressed with Blood: Which Conjecture seemed to me the more probable, since all Animals, of this Kind, are not able to abide the least Time under Water, when their Blood is most expanded with Heat.

But upon the Dissection of an Otter, whose Foramen Ovale was also closed, I found the Veins nothing differing from those of other Animals.

In a Water Tortoise, which I had an Opportunity of examining, with that most dextrous and indefatigable Anatomist Dr. DOUGLASS, I found the two Ventricles of the Heart but half divided by a Septum; and in the Beginning of the pulmonary Artery several strong muscular Rings, at a little Distance from each other; each of which, by contracting, would be capable of resisting a Part of that Blood which otherwise would have been thrown into the Lungs, when they were under Water: And this Blood, so obstructed, must necessarily be thrown into the Aorta; the two Ventricles being, in a manner, one common Cavity: And, when they are out of the Water, this Communication of Ventricles will suffer but little Confusion of the Blood that flows into the Ventricles; because each Ventricle receiving and discharging the same Quantity of Blood, at the same Time, they will balance each other; and thereby such a Mixture will be very much prevented.

MONRO observes, that the Water Tortoise has very large Lungs, consisting of larger Vesicles than Land Animals; and that they receive a greater Quantity of Air to furnish that *Je ne sçai quoi*, so necessary for the Life of Animals.

The same Thing I have observed in Frogs. CHESELDEN's Anatomy.

While Fœtuses continue in Utero, their Muscles commonly act only by their natural Contraction; but sometimes, when the Ease of the Fœtus, or its Preservation, requires a Change of Situation; it seems to perform some voluntary Motions called its Stirrings.

The Posture of a Child is owing to the Muscles being left to their natural Contractions; the stronger ones always prevailing, till their Antagonists exert such a Resistance, by being extended, as brings them to an Equilibrium. Hence the Spine is bowed forward; the Head bended towards the Knees; the Thighs are brought forwards; the Legs bended backwards; the Arms hang down, but are drawn a little forwards; the Fore-arms, Hands, and Fingers, are all bended; thereby the Hands are placed round the Knees. MONRO's Medical Essays, Vol. II.

HOW FAR THE MOUTH, OR THE UMBILICAL VESSELS, ARE NECESSARY TO THE NOURISHMENT OF FœTUSES*.

Several Fœtuses, born without Mouths, being found, on Examination, to have another Passage from the Surface of their Bodies to their Stomachs, have induced Authors to assert the Universality of these vicarious Passages, and bring

* See MONRO, in the Medical Essays, Vol. II.

that as an Argument for the Nutrition of Fœtuses by the Mouth: But others have given accurate and well-vouched Histories of Monsters that had no such Passages.

Three Children*, a Whelp†, and a Lamb‖, were brought forth without Heads, or any Passage into the Chylopoietic; others, with Hands, had no Passage to the Stomach‡: Some, who had a Passage into the Stomach, wanted Intestines**; and into the Intestines of others nothing could get down*†.

These Examples shew the little Necessity there is for either Mouth, or chylopoietic Organs, for the Nourishment of Fœtuses: Yet some, who are of Opinion that it is conveyed by both the umbilical Veins and Mouth, say, that the Supply by the Navel may be wanting, as well as that by the Mouth; and therefore both contributing towards the Nourishment in the natural State of the Fœtus. Whenever one of them is wanting, the other performs the Function of both; as is sometimes done in other Parts of the Body.

A more direct Proof (if it was true) of the umbilical Vessels not being necessary, is offered, by two Examples of Fœtuses that had no Navel-strings.

The first we meet with in Vander WIEL's Observations, of a male Child, fifteen Months old, who was shewn at the Hague in the Year 1683. The Parents of the Child said, when he was born,

* LITRE Mémoires de la l'Acad. des Sciences 1701. MERY ibid. 1720. BUCHNERUS, Act. Med. Physic.

† DE GRAAF De Mulier. Organ. LITRE Histoire de l'Acad. des Sciences 1703. Philos. Trans. No 304.

‖ ANTOINE dans l'Hist. de l'Acad. des Sciences 1703. RUYSCH, Thef.

‡ BELLINGER. de Fœt. Nutrit.

** LEMERY dans l'Histoire de l'Acad. des Sciences 1704.

*† CALDER's Medical Essays, Vol. I.

there was not the least Vestige of the umbilical Vessels, and the Navel was also wanting; but, in lieu of it, a broad, round, red Spot, as large as a Stiver Piece of Money, covered with a very thick Skin, appeared in the Hypogastrium, near the Offa Innominata; within the Circumference of which Spot two Papillulæ, or Aqueducts, were seen, at an Inch Distance from each other, by which the Urine was evacuated.

It seems very evident, that this Child was not really born without the umbilical Vessels, as some Authors thought: What was, then, that red Spot! Nothing else but the Place of the Navel-string, which, after it had dropped off, had closed up in this Manner. And as the Child's Friends were poor, they made it a Prodigy of Nature, to get Money by it.

Dr. MALCOLM FLEMING thinks he has proved, that the Fœtus is partly nourished by the Mouth.

He says, as he was making an Experiment upon the Lungs of a still-born Calf, it came into his Head to open the Intestinum Rectum, which was full of Scybales, or Balls, some of which he spread on a Piece of Paper, to examine at Leisure, which he did two Days after, and found full of Hair, the same with that of the Calf.

He has made several other Experiments on this Subject; all which proved the same. So he concludes, that he had not met with Authors, before he made these Experiments, who had observed to have found Hair. As his Time is entirely taken up in Practice, he has not had Leisure to read many, as he says; therefore he would have us be obliged to him for this important Discovery! as he termed it. But, since, some of his Friends have been so kind as to procure him Books which contain something of the same Observation, &c*.

* See his Account in Philos. Transf. Vol. I. for the Year 1755.

I think we may safely conclude, with Professor MONRO, if, then, accurate Instances are recorded of Fœtuses being nourished without any Possibility of receiving Aliment by the Mouth, or into their chylopoëtic Organs; and if there is no distinct unexceptionable Proof of their being ever supplied with Nourishment without the umbilical Vessels; it necessarily follows, that the umbilical Vessels are absolutely necessary toward the Nutrition of the Fœtus; and that the Mouth is not so.

I shall refer my Reader to the Medical Essays, Vol. I. where MONRO has collected various Opinions, and, in short, whatever can be expected on so obscure a Subject.

OBSERVATIONS.

The Fœtuses sometimes unite, and form monstrous Bodies: Were there in the Ovum, or prolific Matter, monstrous Embryos? Or were these Monsters formed afterwards by a simple Union? by a *Lusus Naturæ*?

But, 1. It is certain, that the Imagination multiplies the Parts of the Fœtus in several Cases. There have been Examples, that Women with Child, after being struck with the Idea of a Monster, have brought forth Monsters. 2. We daily see Children wear the Marks of their Mothers Longings. 3. As Flesh joins; so, by divers Accidents, the two Embryos, when they appear nothing but a milky Substance, may be joined to one another.

There have been Philosophers, who would endeavour to explain the Effects of Imagination on the Fœtus: None but superficial Wits can give satisfactory Explications. We know nothing in the human Body but Matter and Motion. When a Mother is struck with some Object, the Motion increases in her Body, because of the Trouble that
arises

arises in her Soul; this Motion cannot be communicated to the Fœtus but by these two Ways:

1. The Blood and Nerves of the Mother agitate the Womb; this Agitation causes divers Oscillations in the Vessels, or the Roots that fix the Placenta to the Womb; these Oscillations cannot but contract or dilate the Vessels: What will this Dilatation or Contraction produce? A Motion more or less rapid in the Fluids. But that Velocity, or Lensor, will be equal throughout all the Body; therefore one Part will not be more shaken than the other.

Let us even suppose, that Motion augments in one Part; can this Velocity only form a Part organised with all the Proportions, and like to that which strikes the Eye of the Mother?

We must either be very blind, or exceedingly clear-sighted, to conceive such a Phænomenon.

2. The Motion of the Mother may be communicated to the Fœtus by the Fluids that she sends thither.

But, 1. The Blood passes not from one to the other, as we have proved. There is but one Sort of Milk that enters into the Roots of the Placenta: We know how slow the Secretions are. Hence we may conclude, whether the Augmentation of the Motion can be considerable, if nothing but the Milk is the Production of it. 2. If even the Blood should flow from the Womb into the Fœtus, its Motion would be but very slow in the Ramifications of the Placenta; it would run a little swifter in the umbilical Vein, but in entering into the different Parts of the Fœtus, it prodigiously decreases.

Why, for Example, if carried with equal Swift-ness to both Sides of the Head, shall it form an Excrecence on one Side, and not on the other? Why will it break the Legs or Arms of the Fœ-

tus,

tus, because its Mother had seen a Man broke upon the Wheel? Why will it form Figures of Animals that present themselves to the Eyes of a Woman with Child?

Since we have seen, that there is no mechanic Law that can produce this Effect, let us see whether there is no other Cause.

1. If the Author of Nature had established, that, at the Occasions of the Motions and Imaginations of the Mother, it should act on the Fœtus conformably to these Motions and Imaginations, this might be the Cause; but it is not general. There have been Women struck with several Objects whose Impressions appeared not in the Fœtus.

2. If the Creator has established these Laws, it is, in all Appearance, for other Reasons; and this Effect must be looked upon as one of the Inconveniencies found in most Part of these general Laws, and which the Supreme Being did not judge à propos to make Exceptions against.

3. If we might conjecture, in a Matter of such Obscurity, I should suspect, that all this proceeded from plastic Natures, from which the Creator chose to form Bodies that receive Souls. These secondary Causes would act according to necessary Laws which the Creator had imposed on them. As their Actions would not be voluntary, they would not act but according to the Circumstances to which a supreme Law fixes their Action, then a violent Motion would be the Occasion; according to which, that which gives Form to Matter would modify the Fœtus; that hinders me from laying it again immediately upon the Creator, because they make him produce, without any Reason, a new organised Being.

This Inconvenience is not like that which follows the Laws of Gravity, for Example; whence a Motion, more or less violent, results on certain

Occasions, that puts the Texture of Bodies out of Order: But here they introduce God working to form Beings of as difficult Productions as the best organised Bodies, and this without any Necessity. We might rather attribute this Work to depending Causes that were ordered to modify the Matter according to divers Circumstances.

The Resemblance of Children to their Parents may proceed from these plastic Natures which form the Visage according to the sprightly Imaginations of the Mother. We believe, that this Likeness is generally a reasonable Foundation to attribute a Child to a Man; but that is not a Rule: The Cause, which is nothing but the Imagination that rules the Actions of the plastic Nature, shews that a Child may resemble a Man who is not his Father: That which is most surprising is, that Children sometimes resemble their Grandfathers whom their Mothers never saw, and their Fathers have no Resemblance of. In this Case, there is no other Reason to be given but the Ideas of plastic Nature.

But we may say, Children are like their Fathers and Mothers at the same Time, in such a Manner, that the Features of the Mother are more observable than those of the Father, will not appear: But a Mother, who will be more intent upon her own Features than upon those of others, will transmit them to her Child; who, by that means, will resemble his Grandfather.

Some Physiologists advance, that Men might be formed without the Semen's being received by the Woman. We have nothing to do, say they, but heat them by the Warmth of a Dung-hill: But this is false. Those who advance this Opinion, have neither Experience nor Reason on their Side: As if the Generation of our Species was like the Eggs of Hens, &c. We never can demon-

strate

strate that the Semen can produce any Effect while it is not in the Reservoir that Nature destined for it. If the Heat of a Dunghill could unfold the Embryo, could not the natural Heat unfold it better in Men, who retain their Semen a long Time? It would follow hence, that a Man would at last find himself with Child.

I know they have told us some Stories there-upon; but these are Tales that an Anatomist will never believe but by ocular Demonstration, or unless authentic Witnesses aver it.

Some Men, in their Writings, have advanced, that young Women have conceived without the Approach of the Male; but this ought also to be rejected: It is needless to refute such absurd Notions.

The Fœtus respire not; however, some Authors have opposed it. HIPPOCRATES says, that the Fœtus pumps Air through the Nostrils and Mouth; and the great Mr. BOYLE brought some Proof to support a Part of this Opinion, at least.

The Fœtus, properly speaking, respire not, according to his Opinion: Nevertheless, says he, as it appears, by our Experiments, that all Fluids contain Air; it will not be an absurd Opinion to believe that the Fœtus, being somewhat grown, respire a little; since the superior Part of the Amnios is emptied of its Fluid, and filled only with a vaporous Fluid.

He proves it by the Cries of the Child while as yet in the Womb, and the Noise of young Chickens which the Hen has not hatched.

SPON was persuaded, by the same Reasons, that the Fœtus respire in the last Months, but without any great Action of the Muscles of the Thorax. The following are a few Reasons to prove, that there is no Respiration in the Fœtus before its Entrance into the World.

1. The Diaphragm is extraordinarily rarefied. 2. The Lobes are flattened, and raised towards the external Part. 3. As soon as the Lungs have respired, they swim on the Surface of Water, and acquire a vesicular Form. But, 4. When they have not respired, they sink to the Bottom when put in Water, and have not the Colour which the Air gives them when it has entered. 5. If there were any Air in the Lungs of the Fœtus, they would swell when put in the Air-pump; nevertheless this happens not, whatever Exactness be taken in pumping the Air: When they are taken out of that Machine, they sink to the Bottom, as before. 6. In a Word, it is impossible that Respiration should be performed with the small Quantity of Air which is found in the Uterus. 7. That which was advanced about the Cries of the Fœtus before it appears, is absolutely fabulous; the most that could be heard were Grumblings, caused by the Motion of the Waters, and Air of the Vagina or Intestines. What was said concerning young Chickens, is no less false: We never hear them but when the Shell is broken. 8. Some Authors have asserted, that the Placenta performed the Part of the Lungs, and, by its means, the Mother furnished the Fœtus with Air necessary for Life. We cannot deny that there passes a little Air from the Mother to the Child: But does that prove Respiration in the Child itself? BERGERUS says, that the Fœtus has no need of Air to counterbalance the Pressure of that which the Mother is environed with, because it receives from the Mother a Portion of Lymph very much rarefied, which is enough agitated by the Æther. 9. The Motion of the Blood is very slow in Dogs, which are yet inclosed in these Waters. We scarce feel the Pulsation of the Heart; but when the Animals have once respired,

spired, the reciprocal Motions of the Thorax make the Blood flow with Rapidity.

HARVEY delivers a Proposition which is not easy to be solved. He asks, How it is possible that a Fœtus, coming into the World without its Coverings of the Womb, can live long enough shut up in these Waters? And why it dies (when it has once respired) if Breath fails it?

1. Some have answered, That the Blood circulates no more through the Foramen Ovale, as soon as the Fœtus has respired. If this were so, it is evident, that as soon as the Fœtus received Air in the Lungs, it could have no more Life when it respired not.

KERKERING seems to confirm this Idea, when he says, that the Foramen Ovale is closed in the Fœtus respiring, by means of its Valvulæ. For the Blood, returning from the Lungs, fills the left Auricle, and applies the Valve to the Hole.

But if we examine this Answer with Attention, we shall see, that it cannot satisfy the exact Inquirer.

1. Experience teaches us, that the Foramen Ovale does not close so soon: The Opening is seen, sometimes, three or four Months after. There have been Subjects of grown Persons who had their Foramen Ovale open.

2. In Inspiration the Blood enters into the Lungs, and goes out by Expiration: According to this Opinion, when the Child wants Air, the Blood cannot circulate in the Lungs, since Inspiration cannot be performed. These Lungs emptied, transmitted their Blood to the left Auricle, which propelled it into the left Ventricle; thence it returns again into the right Auricle by the Vena Cava. Why cannot this Blood pass through the Foramen Ovale, as when in the Womb?

3. The only Difference found in the Circulation of the Blood of the Fœtus is, that it is obliged to pass into the inferior Parts in larger Quantities; but this Difference cannot hinder the Circulation through the Foramen Ovale.

4. BERGERUS says, That the Fœtus is not exposed to the Pressure of the Air when it is in the Womb, and in its Waters; but if the Air touches it not immediately, it presses it as much by means of the Membranes and Water: Therefore this Reason is not sufficient. Besides, in case the Air should compress the Fœtus more out of its Membranes; I do not see that this ought to hinder Circulation through the Foramen Ovale. On the contrary, the Air, in pressing the Thorax, should reduce the Lungs to a small Extent, the same as before Respiration; therefore every Thing would be found in the Situation which was necessary for the Circulation of the Blood as before its Birth.

5. I know not how HARVEY made his Experiment: Perhaps he put a Fœtus, just born, into an Air-pump. If this was the Case, it would not be surprising that Death followed the Privation of the Air; for then the whole Machine is disordered by the Defect of the Equilibrium which is found between the internal and external Air.

If HARVEY stopped the Respiration of any Fœtus, and did it either in Inspiration or Expiration; if in Inspiration, we see that the Air, being stopped in the Lungs, will not permit the Blood to circulate, since it will with Vehemence enter the Lungs without being propelled there; if during Expiration, I see not how this Phænomenon may be explained. Perhaps we may say, that the Air, which is always in the Lungs, rarefies it so much, by its Heat, that it kills the Fœtus.

A certain Author mentions an Example of a Soldier who found a Womb in the Water, which inclosed a Fœtus still living in it.



LECTURE XIX.

Of the GRAVID UTERUS, and the Exclusion of the FOETUS.



AS the Foetus grows larger, so the Matrix increases proportionably; the serpentine Arteries, of which it is composed, being extended by the impelled Blood, and stretched into a more direct Course. Thus its Thickness continues the same; because the great Quantity of Blood, which dilates the Arteries and Veins, makes up for the Extenuation of the solid cellular and fibrous Substances; and the Fundus, especially, increases more than the rest; so that, by dilating the above Tubes, these last seem thus to descend from the Middle of the Uterus, which, at present, by Degrees rises from the Pelvis, even as high as the Stomach itself, so as to compress all the abdominal Viscera, and more particularly the Bladder and Rectum.

During this whole Time of the uterine Gestation, the Os Tincæ is never perfectly closed, and defended from the Air by a thick Mucus from the Sinuses, nay, perhaps from the Vesicles which are situated in the Cervix of the Matrix, then being compressed, oozing out, more or less, their Contents; which make Women with Child always wet, more or less, as they complain. Therefore it is quite idle to imagine, with some Authors, that

this Mucus, or, as they call it, Corpus Luteum, glued up the Orifices of the Womb.

The Cervix of the Uterus itself yields to the Extension of its Body, so as to become exceeding short, and forming a broad flat Aperture, of no sensible Length; which, about the Time of Parturition, is always more relaxed.

The Fœtus, in the first Months, has no certain fixed Situation; but, being grown to a considerable Volume, is, about the Middle of the Time of Gestation, folded together in such a Manner, that its Head lies between the Knees; and, being the heaviest Part, it subsides, by Degrees, more and more towards the Cervix of the Uterus.

The increasing of the Fœtus excites, at first, uncommon Commotions, by which the Sides of the irritated Uterus endeavour to disengage themselves; and at length, towards the Conclusion of the ninth solar Month, when both the Weight and Restlessness of the Fœtus often thicken the Womb, become now intolerable. Its Head is, by the Reaction of the Uterus and Abdomen, impacted, somewhat like a Lump, into the Pelvis, so as to give the Mother great Uneasiness, as if a Quantity of Fæces was collected for Exclusion in the Rectum: In Consequence of which, Pain obliges her to strain, which facilitates and forwards the Delivery.

The Tenesmus thus increasing till it is no longer tolerable, the Mother uses all her Efforts by very deep Inspirations, which press the Uterus and Viscera downwards; and at the same Time the Uterus itself, by its contractile vital Force, now increased by the Stimulus, constricts itself so powerfully about the Fœtus, as sometimes to exclude it, without further Help from the Mother, &c.

Now

Now the Amnios, filled with the Waters, is first protruded vertically, before the Head of the Fœtus, so as to dilate the Os Internum Uteri; in which the Membranes, being by Degrees extenuated and dilated, easily break, and diffuse their Contents; which lubricate the Passage, and relax the Parts of the Vagina.

The Head of the Infant naturally presents itself with the Face to the Os Sacrum, being directed that Way by its Weight; and being urged forwards, somewhat like a Wedge, it further dilates the Os Uteri; till at length, by the more powerful Efforts of the Mother, the Head of the Child is thrust out through the distractile Vagina, with intolerable Pain generally to the Mother, and an universal Tremor of Body; and if none of the Bones of the Pelvis happen soon to press unequally, the Child easily advances, and is soon born.

The Uterus, which hitherto had been distended beyond Imagination, now contracts itself, by the elastic Power of its Fibres, so suddenly and powerfully, as often to catch and embarrass the Hand of the Deliverer; and sometimes retain the Placenta, if it be not soon loosened, and withdrawn.

By separating the Placenta from the Matrix, the uterine Vessels bleed, but are compressed no less than by the Elasticity of their own Tunics; whence a large Quantity of Blood, which was collected in the uterine Substance, flows out, and is named Lochia; at first a mere Gore, but afterwards its purple Colour changes, by Degrees, to that of a yellow Serum; and as the Openings of the Vessels contract themselves more, they at length become of a whitish or wheyish Colour; and then the ample Excoriation of the Uterus soon recovers a new Epithelium, or Cuticula, and shrinks up to a Bulk not much exceeding that of the primitive Volume.

Though

Though the Time of Delivery is pretty fixed, yet it may happen in one or more days, nay, in the same Woman at different Births; but it is always certain as to the Month; seeing it happens from the fifteenth Day of the ninth Month to the End, or thirtieth Day of the same. And though some Women assure us, that Delivery may happen sooner or later than the fixed Time we here mention; yet I suspect, very much, that they are wrong in their Reckonings, as not being exactly certain of the Time in which they conceive. For, that Nature should be uniform in her Functions, it is necessary that Woman should have her limited Time, as well as other Animals: Nevertheless, I am of Opinion, that several Circumstances may promote or retard the Delivery for some Days.

Authors are variously divided in respect to the Exclusion of the Fœtus. Some attribute it to the Collection of the Meconium, which irritates the Intestines of the Fœtus, and makes it struggle in the Uterus, and endeavour to get out of it: Others think, that it is the Acrimony and Irritation of its Urine in the Bladder: Others, again, will have it, that it is the Difficulty of the Uterus in yielding to the Volume of the Fœtus. It may be, probably, that the stimulating of the Meconium and Urine, the Smallness of the Matrix, with the Difficulty it has to dilate after a certain Extension, may contribute to the Exclusion of the Fœtus at the ordinary Term: But, however, I think we ought likewise to consider the Posture of the Fœtus.

We are to observe, that the Fœtus is in an *Æquilibrium* with the Water which surrounds it in the Membranes of the Placenta; its specific Gravity being the same with that of the Waters; it freely, without Constraint, floats therein, and is equally compressed on all Sides, the included Fluids

ids rendering the Compression uniform and gentle; in lieu if the Fœtus lay dry in the Uterus, it would be continually subject to unequal Contractions of the Matrix and adjacent Parts.

In this State the Fœtus has its Head upwards, and Feet towards the Orifice of the Uterus, with the Face to the Mother's Abdomen: During the first six Months it commonly remains in this Situation, the Head being towards the Mother's Navel; for its Feet are, during that Time, specifically heavier than the Head: But this Part begins, at length, to grow proportionably faster than any other; wherefore its superior Weight turns the Fœtus, with its Head downwards, to the Orifice of the Uterus.

This Change of its Situation is owing to the speedy Growth of the Brain, &c. which generally happens about three Weeks or a Month before the Time of the Delivery, when Women say their Bellies are fallen, and find themselves somewhat lighter, and more active, than before; but feel a greater Weight on the Orifice of the Uterus by the Compression of the Fœtus's Head and Shoulders.

It may be demanded, What is it that disposes the Orifice of the Uterus, with the Vagina and Vulva, to dilate themselves, and give way to the propelled Fœtus; and what are the Vires, or Momenta, which exclude it?

1. We answer, That the constant Compression of the Head against the internal Orifice of the Matrix gradually expands the infarcted Organs of the Vessels, Vagina, &c. whence they become œdematous by the Stagnation of the Serum, which continually bathe and relax these Parts prodigiously, so that they may be considerably distended without any Laceration.

2. What

2. What are the Powers which exclude the Fœtus?

We answer, They are partly the various Strata of muscular Fibres of the Uterus which constrict it, as every Midwife may be sensible of, when they depart the Placenta from the Matrix; at which Time we easily feel its Constriction*. Besides, we are to add, that the abdominal, diaphragm Muscles, &c. concur also for its Exclusion.

Some Authors have imagined, that the Offa Pubis yields, at the Time of Delivery: But I think they must never rightly consider the Mechanism of their Ligaments, otherwise they certainly would not have thought so.

As for SAVIARD's having related that he heard the Bones of the Pelvis of a Woman crack; I am rather inclined to think that it was the Offa Femoris in the Acetabula.

The Fœtus in Utero, as we have observed before, has its Head, for about six Months, towards the Mother's Navel; that, by this Situation, the Placenta may the better adhere to the Matrix: Soon after, it is turned downwards; the Uterus is sollicitated, by its Weight, to yield, at the Orifice of this Organ, to the propelled Chorion and Amnios; which, with the Waters they contain, form a kind of small Vesicula in the Orifice of the Uterus. This Protuberance ought not to be bursted too soon, but should remain till the Woman is really in Labour: For if the Waters evacuate too early, the Delivery is generally the more difficult; as these Waters or Liquors facilitate the Exclusion of the Child.

* RUYSCH fancied that he had found a circular Muscle in the Fundus of the Matrix, which he thought was for the Exclusion of the Fœtus.

Thus the Child gradually advances enlarging its Passage till it is excluded out of the Womb: When it is thus protruded into the Vagina to its Ears, it is said to be in the Passage.

We should not be surpris'd that the Infant should so easily pass where its Head did: For it is geometrically demonstrat'd, that the Circumference of its Head is greater, or at least as great, as that of its Shoulders. But this Proportion of the Head and Shoulders is observed only in Infants; wherefore, if the Child's Head once passes, the rest soon follows; except a Misconformation of its Shoulders be too large.

The Infant being thus in its Passage, if the Membranes should not be lacerated, we ought to do it, in order to let out the Liquors, to lubricate the Parts, which facilitates the Delivery.

After the Child is born, and Navel-string tied about two Fingers Breadth, the next is the Placenta, which usually soon follows the Child; but if it still adheres to the Uterus, the Midwife must disengage it gently, without Violence.

We are now to observe the Symptoms which follow Parturition.

The first and chief is, a sanguine Evacuation, or kind of Hæmorrhage, proceeding from the parting the Placenta from the Appendices Cæci, or Sinuses of the Uterus, which are, at this Time, very large, and turgid with Blood; whence the Flux is sometimes very considerable, but seldom dangerous. On the contrary, if it be stopp'd before the uterine Vessels are evacuated, it is always of bad Consequence to the Woman.

This Evacuation is named Lochia, lasts sometimes only about an Hour, and retains a sanguineous Colour for three or four Days, sometimes only two. This sanguineous Evacuation gradually grows of a higher Colour, and about the End
-of

of ten or twelve Days the Flux is generally purely lacteal; and, lastly, lymphatic: However, this varies, according to the Temperament, Climate, and other Circumstances.

Dr. ASTRUC says, he has seen some Women who have had the Lochia for six Weeks, or not over till the Menstrua appeared.

While they flow, and pass through the different Degrees already observed, the Uterus and Appendices Venosæ are contracted in the same Proportion; and the Colatoria Lactea, which compressed them, are also evacuated*.

Preternatural Births are occasioned by the Situation of the Child in the Time of Labour, opposite to what we have before observed.

The first is, when his Feet, either separately or jointly, present themselves first to View. In this Case, the Midwife should observe if there are not more than one Infant in the Womb, for fear of taking hold of a Foot or Hand of each of them. Whatsoever Parts the Child presents for Birth, except its Head, we call preternatural, which are attended with great Difficulty in delivering the Woman of a live Child: However, we ought always to use our utmost Endeavours to procure a

* When the Time of Delivery approaches, the Orifices of the Matrix begin gradually to dilate. The Midwife ought to introduce the Fingers into the Vagina, to know the State of the Uterus, and the Posture of the Child; whether it be his Head, Hand, Foot, Placenta, &c. which presents itself for the Birth; which Parts are easily distinguished by expert Midwives; and to take Care not to mistake the Protuberance of the Membranes of the Fœtus with the Waters, for the soft Part of his Body.

The Child may be in its natural Situation for Birth, yet cannot be delivered; occasioned either by Misconformation, or a Collection of the Ossa Ilii within the Sacrum, or from the Enormity of the Child itself, &c.

☞ I intend not here to give a System of Midwifery, as that Subject properly belongs to the Practice of Surgery; which, if these Lectures be generously received by the British Tyros in Anatomy, I may hereafter publish another Course of Lectures upon the Theory and Practice of Surgery.

natural Birth first. As for the Use of a Forceps, Fellets, or Crotchets, I reject them; the best Thing is the Hand, for the Delivery of a Child alive. In Fact, I am inclined to think, that the Author or Inventor of the Forceps, &c. contrived them to supply the Deficiency or Enormity of his Hands; which I farther think is very unkind to the fair Sex, to attempt helping them at the very Time when they generally find their Burden too large for the Parts, without adding a clumsy Hand. Therefore Women should examine the Hand of the Midwife she intends to employ.

I shall here take the Opportunity to recommend one of the best Essays which has been wrote in the English Language, by the ingenious Dr. JOHN BURTON of York. I have not the Pleasure of being acquainted with the Author; therefore the Public cannot accuse me of being partial: For there are other Books, of this Kind, wrote by Authors of Fame, perhaps, in London, which are quite defective.

OBSERVATIONS.

A LACERATION OF THE UTERUS*.

The frequent sudden Deaths of Women in Child-bed are often very afflicting to whole Families. In most Cases of that Kind, an Hæmorrhage has been blamed, and perhaps not always without Reason: But I have discovered Causes of it, which are still more insuperable.

On the First of July 1747. there was brought to the Theatre a Woman who was delivered after a very hard Labour, attended with cold Sweats. I dissected her about Half an Hour after her Death,

* Extracted from HALLER's *Opuscula Pathologica*.

and found a large Hole in the left Side of the Neck of the Womb, both in the Cervix itself, and in the Peritonæum, which connects the Uterus to the Vagina. The Cervix was full of confused Valves, the Uterus itself almost scirrhus, very thick, and though thinner at the Interval between the Fallopian Tubes than elsewhere, yet even there it was a full Inch in Thickness, and had a great Number of white transverse Fibres. In the middle Space above the Cervix, the Uterus was almost two Inches thick, compact, and full of small Orifices of Arteries. That Part to which the Placenta had been fixed, had a great many little Portions of the Chorion adhering to it: The Adhesion of the Placenta had been circular between the Fallopian Tubes, which went off below the Middle of the Uterus, and were pendulous, as usual.

One of the Ovaria was quite sound; in the other a small Foramen appeared, together with a vascular pellucid Tumor. From the Foramen went a pellucid Vein, not very small; and an Incision being made in the Tumor, it appeared to be a Corpus Luteum, spherical, separable from the Ovarium, yellow, vascular, furrowed, and clustered like a Bunch of Grapes, without any Fovea. Under it were Vessels of a pretty large Size, and in the same Ovarium there were likewise other small Ova, as they are called.

In the Cervix of the Uterus, a little above its Orifice, were a great many large, oblique, mucous Sinuses. The inferior Duct, situated near the Middle of the Vagina, was about an Inch long, and without any Gland.

The anterior Rugæ of the Vagina were sound, and the Sinuses at the Urethra full of Mucus. The internal Membrane of the Uterus was thin, smooth, adhering very firmly, and here and there
porous.

porous. Under it was an immense Number of Veins, which were very turgid.

The fleshy Substance of the Uterus was full of Chinks, unequal, lobular, conglomerated as it were, and of a white Colour.

The Uterus itself properly so called, was of a globular Figure.

II

On the Fourth of September 1748, another healthy Woman died in Child-bed. The Uterus was near five Inches long, and as many broad, flattened both before and behind, extended a little above the Margin of the Os Pubis, and covered the Bladder. A little below the Cornua of the superior Part of the Uterus, not far from the Middle, came out the Fallopian Tubes; and the Convexity of the Uterus between the two Tubes did not exceed that of a Woman who is not pregnant. Having injected it with Wax, I perceived a Hole in the Uterus on the right Side of the Orifice. Upon farther Examination, the spongy Flesh at the Orifice of the Uterus was found degenerated into a great Number of grumous, very thin, reticular Membranes, without the least Appearance of the Ring which is commonly found there. In the same State was the contiguous Part of the Vagina; and where its Texture was not quite destroyed, it consisted of Fibres and cellular Membranes cohering weakly together, and variously intersected. The upper Part of the Vagina was very much dilated, but not so as the inferior. In the spongy Part of the Uterus it was thickest, but at its Bottom it did not exceed six or eight Lines. Instead of Sinuses, I observed a kind of smooth cylindrical Veins, full of Ramifications. The Ligaments were also of an unusual Thickness.

III.

On the Eighth of November 1740, I dissected a young Woman who had taken some strong Purgatives, in order to procure a Miscarriage, and died in Convulsions within fifteen Minutes after she was delivered.

The spermatic Vessels, as VESALIUS formerly observed, were an Inch thick; the Uterus was raised a few Inches above the Pelvis, collapsed, firm, pulpy, and thick.

The Cervix of the Uterus was torn, and thro' the lacerated Part, the Head of the Foetus had passed, about an Inch above the Pudendum. In the sound Part the Rugæ had scarce suffered any Alteration, the internal Part of the Orifice of the Uterus was wide open, appeared to be lacerated, was thin, flocculent, and about two Inches broad. The Inside of the Uterus was full of Blood, which being washed off, there appeared a great many white, ragged, flocky Substances, as if the Texture of the Uterus had been converted into Wool. More internally, I observed a Number of very thin membranous Lamellæ, an Inch or more in Breadth, which consisted of the Chorion, so grown to the Uterus as to put on the Appearance of its internal Membrane.

In the Substance of the Uterus, which was more than six Lines thick, there were a great many Orifices of Veins, into which Air being blown, it passed, in the Form of Bubbles, through Orifices of different Sizes, some being pretty large, and others very small, into the Cavity of the Uterus.

The muscular Fibres were red, broad, disposed into Lamellæ, very numerous, and in various Directions. It was hardly possible to reduce them into Order; some of them descending to the Orifice of the Uterus, some surrounding it transversely, and

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and many of these last immersed, as it were, in the former, which they exceeded, both in Number and Size.

The Valves of the Neck of the Uterus were slender, at a considerable Distance from each other full of very small Pores and Lacunæ.

The Tubæ Fallopianæ, which were very long, and the round Ligament came out of the Fundus of the Uterus. This last was sent off long before *POUPART's* Ligament, and terminated in vascular Filaments,

In the Ovarium there was a Fissure, and a pellucid Corpus Luteum, not exactly hemispherical, of a reddish-yellow Colour, and hollow. The Cavity was Half a Line broad, not deep, but very vascular at its Bottom; and besides there were pretty large Ova, about two Lines broad, contained in the same Ovarium. Wherefore the Ova are not consumed by the Corpus Luteum.

* In the two Uteri, where the Neck of the Womb was lacerated, the Side of the Neck was burst, which seemed to be owing to the oblique Situation of the Fœtus at the Time of Birth; for it is probable, that its Head did not present itself directly against the Orifice of the Uterus, but pressed against the Side or Neck of it; and thus the Vessels of the Neck being pressed, the Circulation of the Blood through them was obstructed. Hence the Veins, which at that Time were both very large and thin, easily burst; and the Blood, being poured out both from them and the Arteries into the adjacent cellular Substance, a Swelling was produced, with a Suggilation, Softness, and a kind of Mortification in the Neck of the Womb. And, lastly, by repeated Efforts of the Head, not directly against the Orifice of the

* Ad Disp. JOACH. VOSSE, 1749.

Womb, but the Sides of the Orifice, the Neck came to be lacerated.

These Things appear to me to be so evident, as not to require any Demonstration.

This oblique Posture of the Fœtus, to which I impute the bursting of the Uterus, has been represented by FLEURY and DEVENTER; Fig. 37, 38.; but, as far as I remember, without taking any Notice of the fatal Event which I think is to be apprehended from it.

MULLER, who likewise met with a Case of the same Kind, has given a more full Account of it in his *Diff. qua Casus rarissimus uteri in Partu rupti sistitur.* Basil. 1745.

In Relation I. of a Woman, out of whose Womb a Child had been newly taken, I said, that the rugous Ring of the Vagina was not obliterated; and the Case was the same in another Body, the IIId, which induces me to conclude, that these Rugæ are either quickly restored, even within a few Minutes after Delivery, which seems scarce probable; or that they are not entirely designed for the more easy Extension of the Vagina by their Dilatability.

In Women who have died in Labour, I have always seen Processes of the Chorion so intimately connected with the Uterus, and so perfectly resembling it, that there seems no manner of doubt of something being transmitted that way to the Fœtus by the Uterus. On this Occasion, however, I must not omit mentioning, that this very Winter I saw in a Fœtus, that had been injected by the umbilical Vessels, a pretty large Artery filled with Wax; and its Branches dispanfed.

RUYSCH *Epist.* XIII. p. 10. NOORTWYCH *De Uter. grav.* p. 14. and several others, have denied the Existence of any red Vessels, capable of being injected, in the human Amnios.

Lastly,

Lastly, It is certain, as I have elsewhere observed, that as these Villi of the Placenta are almost invisible, so the Orifices of the Veins of the Uterus, which open between the muscular Bands of Fibres, are very large: But this does not hinder lesser Veins likewise from opening into the Cavity of the Womb; and even these are very large, when compared with the Villi of the Placenta, as Professor MONRO has justly remarked, in his Medical Essays, Vol. II. p. 134.

Wherefore it appears, that many small Arteries of the Placenta open into one single Vein of the Uterus.

After I had published my Commentary upon BOERHAAVE, I found in three Bodies, where the Uterus was burst, and in other pregnant Uteri, that the Tubes are very little affected by Pregnancy; and that the Part of the Uterus between the Tubes is not much increased, and but a little convex: But as in pregnant Women the Tubes are almost pendulous, and therefore parallel with the Uterus; hence it seems to have happened, that DEVENTER, Lum. Obstet. p. 400. and other anatomical Writers, have made the Tubes, during that State, to go out a long Way below the upper Part of the Uterus.

Dr. PARSONS * likewise observes, that there can be no such Thing as Superfoetation; because, in pregnant Women, the Tubes come out below the Fundus of the Uterus, and cannot reach to the Ovaria.

But these Assertions are disproved by many Experiments, which have lately been made.

For it is certain, that Superfoetations do happen. And in pregnant Women I have seen the Tubes of such a Length, as to be capable of reaching the Ovaria very easily.

* See him, on Muscular Motion.

The Corpora Lutea I have so frequently met with in Women, that I now look upon it as nothing uncommon; yet I shall add a few Remarks upon this Subject.

1. I never saw two Corpora Lutea in one Woman. 2. I never saw a Corpus Luteum where the Woman was not pregnant, or even for any considerable while before the Time of Labour; and, consequently, never before Puberty: All which is very different from the Doctrine of VALISNERIUS, and others.

The Corpus Luteum does not consume all the Ova; for I have seen great Numbers of them along with the Corpus, contrary to what several Authors have asserted, particularly BOERHAAVE.

In the human Fœtus, and indeed before the Age of Puberty, I have never met with any Ovula; the Ovaria, before that Age, being long, narrow, flat, without any Prominences, and in their Figure and dry Texture very different from those of adult Females.

These Truths invalidate the Observations of VALISNERIUS, and some other Authors of Reputation, who describe the Ova even in Fœtuses and new-born Animals, as if they had really seen them.

Those Women who expire after a very hard Labour, oppressed with Faintings, cold Sweats, and excessive Weakness; for the most Part do not owe their Death so much to the violent Hæmorrhage (which I do not believe to be so suddenly mortal, from the Examples of Persons who have been wounded), but rather to a Laceration of the Uterus. For in those who have had that Part wounded from different Causes, as has appeared after their Death, I have observed the very same Symptoms to happen, as in those who too often are carried off within Half an Hour after Delivery:

But

But whether the Rashness or Unskilfulness of Midwives, or incurable Diseases, prove fatal to the Patients, the Grave, for the most Part, prevents our discovering.

In Women who have died of acute and spotted Fevers, I have often seen the Blood ooze spontaneously out of the Mouth; and this has given Birth to the Story of Vampyres, which lately made so much Noise all over Europe, and was first propagated by some imperial Troops quartered in Hungary; viz. Persons who had died of acute Diseases, and especially Women who had perished in Child-bed, and been hastily buried, as is usual in hot Climates, were found, upon opening the Graves, with their Mouths foaming with Blood. The other Particulars were the Fruits of Imagination.

The first Account I meet with, of this epidemical Superstition, is in ANTHONY GALATHEUS.

The Cause appears to me to be no other than the Expansion of the elastic Air contained in the Lungs, which forces upwards the Blood with which that Viscus is overcharged towards the End of those fatal Diseases, from the broken small Vessels, resembling, in some measure, the foaming of fermenting Liquors.

This morbid State of the Uterus and Vagina shews, that these Parts consist of a common Membrane: For nothing can more resemble the common cellular Structure than the lacerated and mortified Fibres of those that have no certain Direction, nor any considerable Length; but, on the contrary, are short, and interwoven with one another in all Directions.

The same Structure also obtains in the Tendons, as appears from those of the slender Kind; for Example, that of the plantaris or palamaris Muscle, the Expansion of which forms a Membrane

resembling that which in the Bladder or Stomach is called nervous, and which ALBINUS has demonstrated to be of that Kind.

The Sinuses of the Uterus were communicated in Comm. BOERH. as well as several other Observations, by Persons of distinguished Reputation. These, after repeated Experiments, which at that Time were but few, I classed among the Veins in some Essays since published; and this Opinion I have since confirmed by five or six late Dissections of Women who had died in Child-bed. For they are continued with the Veins, branched like them, and subdivided into smaller Ramifications, and, lastly, evidently sheathed in that thin tender Membrane which covers the Veins.

The Cause of the inaccurate Description formerly given of these Sinuses, seems to be owing to their large Size, unequal and easily-extended Diameters, and the unaccountable Largeness of their Orifices opening into the Cavity of the Uterus. By injecting the Veins with Wax, Models are formed of these Sinuses; but they are very irregular, as is usual in the Veins; and here the more so, the farther the Vessels recede from the natural State of the pregnant Uterus. Neither is that extraordinary Dilatation observed to take place equally in all Parts of the Uterus.

But whether the Sinuses which MALPIGHI has described, in the Uterus of a Cow, are of the same Kind with these, or rather, whether they are true Sinuses; I shall not yet take upon me to determine.

The Laceration of the Vagina I attribute to the Want of Dexterity in a Midwife; who, in order to extract the Foetus, had forcibly thrust both Hands up the Vagina: For it could not be owing to the Foetus alone in its Passage; seeing every Body knows how easily it makes the rest of its
Way,

Way, as soon as it has passed the internal Orifice of the Uterus.

Most Authors have alledged, that the Orifice of the Uterus becomes thinner in the Time of Labour; but it is only to be understood in this Sense; viz. the thick and annular Portion of the Uterus, which is produced into the Vagina, the larger the Opening of the Orifice is, the more it resembles Part of the Uterus; and both the Prominence of the Uterus into the Vagina, and the circumscribed circular Furrow between the Part of the Vagina and the circular Production of the Uterus disappear at the same Time.

These Remarks I have thought proper to add to Note V. p. 389. Comm. BOERH. Tom. V.

I have frequently seen the muscular Fibres of the Uterus in Women who have died in Childbed, but never more beautiful than in this Subject of which I now write. There is no doubt but RUYSCH saw the same, and called them the Muscle of the Uterus. They are true Laminæ of parallel muscular Fibres, lying upon one another in different Directions, which I never have been able to reduce to any regular Order. Between these Fibres are a great many Interstices, both large and small, of no determined Figure, opening into the Cavity of the Uterus; and these are the Orifices of the absorbent Veins of the Uterus, at this Time dilated to their largest Diameter. So that what I said before, concerning the Fibres of the Uterus, seems now sufficiently confirmed; and it is the same Thing to me, whether they are termed muscular Fibres, or a Muscle.

Thus most anatomical Authors speak of the muscular Tunic of the Bladder: H. FABRICIUS, COWPER, Drs. DOUGLAS and PARSONS, have looked on it as the Detrusor Muscle.

I the more readily quote this Instance, from having observed a very great Affinity between the Fibres of the Uterus about the Time of Labour and those of the Bladder. But that the Delivery of the Remains of the Placenta may be effected by these Fibres, is a Point justly questioned: For it is very certain, that Clots of extravasated Blood, though they are loose, and evidently less compact than the Placenta, are frequently confined in the Womb, and condensed into fibrous Masses, which sometimes at last adhere to the Sides of the constricted Uterus: And I have often found the Chorion, several Months after Pregnancy, grown firmly to the Uterus.

By what Mechanism these Fibres can expel the Placenta, when it adheres to the Uterus, I cannot conceive: Though I am far from denying, that when it floats loose in it, they may be capable of forcing it out, in the same Manner as they do Clots of extravasated Blood.

The above Observations are taken from HAL-
LER's Opuscula Pathologica Sectiones Cadaverum
Morboforum, &c.





LECTURE XX.

Of the MAMMÆ.



THE Name of Mammæ, or Breasts, is given to two Eminences, more or less round, situated in the anterior and a little towards the lateral Parts of the Thorax; their Center, or middle Part, lying almost opposite to the osseous Extremity of the sixth true Rib, on each Side. Their Size and Figure vary in the different Sexes and Ages.

In Children of both Sexes, and in Males of all Ages, they are commonly no more than cutaneous Tubercles, or soft Verrucæ, of a reddish Colour, called Papillæ, or Nipples, each of them being surrounded by a small, thin, and pretty broad Circle, or Disk, more or less of a brownish Colour, and an uneven Surface, termed Areola.

In Females arrived at the Age of Puberty, which is sometimes sooner, sometimes later, a third Part is joined to the two former, which is a convex Protuberance, more or less round, of about five or six Fingers in Breadth; the Papilla and Areola being situated near the Middle of its convex Surface. This is what is properly termed Mamma; and it may be termed the Body of the Breast, when compared with the other two Parts. It increases with Age, and is very large in Women with Child, and those which suckle Children: In old Age it de-

decreases, and becomes flabby, losing its natural Consistence and Solidity.

The Body of the Mammæ is partly glandular, and partly composed of Fat; or it is a glandular Substance mixed with Portions of the Membrana Adiposa, the cellulous Pelliculæ of which support a great many Blood-Vessels, Lymphatics, and serous or lactiferous Ducts, together with small glandular Moleculæ which depend on the former; all of them being closely surrounded by two Membranes continued from the Pelliculæ.

The interior of these two Membranes, which is, in a Manner, the Basis of the Body of the Mamma, is thick and almost flat, adhering to the Musculus Pectoralis Major. The second or external Membrane is thinner, forming a particular Integument for the Body of the Mamma, more or less convex, and adhering closely to the Skin.

The Corpus Adiposum of the Mamma, in particular, is a spongy Cluster, more or less interlarded with Fat, or a Collection of membranous Pelliculæ, which, by the particular Disposition of their external Sides, form a kind of Membrane shaped like a Bag, in which all the rest of the Corpus Adiposum is contained. The anterior or external Portion of this Bag, or that which touches the Skin, is very thin; but that Side next the Pectoralis Major is thick.

The glandular Body contains a white Mass, which is merely a Collection of membranous Ducts, narrow at their Origin, broad in the Middle, and contract again as they approach the Papilla, near which they form a kind of Circle of Communication. They are named Ductus Lactiferi.

The coloured Circle, already mentioned, is formed by the Skin, the inner Surface of which sustains a great Number of small glandular Moleculæ, of that Kind which MORGAGNI calls Glandulæ

dulæ Sebaceæ. They appear very plainly all over the Areola, even externally, where they form little flat Eminences, at different Distances, quite round the Circle.

These Tubercles are perforated by small Apertures, through which a kind of sebaceous Matter, more or less fluid, may be squeezed out. Sometimes this is a serous Liquor, sometimes a milky Serum, and sometimes pure Milk, especially in Nurses; and I have seen both serous and milky Drops come out at the same Time.

From whence I am inclined to think, that these Apertures communicate with the lactiferous Ducts; and that the Tubercles are a kind of auxiliary Papillæ added to the true ones. The different Liquors which may be squeezed from the same glandular Body, give also room to think, that the Foramina in them communicate, by their Extremities, with several other smaller ones.

The Tubercle which lies in the Center of the Areola is termed Papilla, or the Nipple. It is of different Sizes in different Ages and Constitutions, and in the different Conditions of Females in particular. In Women with Child, or who suckle, it is pretty large, and generally longer or higher than it is thick or broad; and when it happens to be short, it causes great Uneasiness to the Child.

The Texture of the Nipple is spongy, elastic, and liable to divers Changes of Consistence; being sometimes harder, sometimes more flaccid. It seems to be composed chiefly of ligamentary Fasciculi, the Extremities of which form the Basis and Apex of the Nipple. These Fasciculi appear to be gently folded or curled throughout their whole Length: And if, by drawing the Fibres out, these Folds be destroyed, they return again, as soon as that Action ceases.

Between these spongy and elastic Fasciculi lie seven or eight particular Tubes, at small Distances from each other; and all in the same Direction: These Tubes end at the Basis of the Papilla in the irregular Circle of Communication of the lactiferous Ducts, and at the Apex, in the same Number of almost imperceptible Orifices; and as they are closely united to the elastic Fasciculi, they are folded in the same Manner with them.

The Body of the Papilla is covered by a thin cutaneous Production, and by the Epidermis. Its external Surface is uneven, being full of small Tubercles and Wrinkles; among which, those near the Circumference of the Nipple seem to have a transverse or annular Disposition, which, however, is not uniform.

This Disposition, or Direction, seems to belong to the elastic Folds already mentioned; and from this simple Structure it is easy to explain how Infants in sucking the Nipple, and Women in drawing the Teats of Cows, bring out the Milk. For the excretory Tubes, being wrinkled in the same Manner as the Fasciculi, do, by these Wrinkles or Folds, as by so many Valves, hinder the Milk, contained in the Ducts, from flowing out; but when the Nipple is drawn and elongated, the Tubes lose their Folds, and the Passage becomes streight. Besides this, when they are drawn with a considerable Force, the whole Body of the Mamma is increased in Length, and contracted in Breadth, and thereby the Milk is pressed into the open Tubes; and thus, by barely pressing the Body of the Breast, the Milk may be forced towards the Nipple, and even through the Tubes.

The Arteries and Veins distributed through the Mammæ, are Ramifications of the Arteriæ and Venæ Mammariae; of which, one Kind comes from the Subclaviæ, and are named Mammariae Internæ; the

the others from the Axillares, called *Mammariæ Externæ*.

These Vessels communicate with each other, with those near them, and with the *Vasa Epigastrica*, as was observed in the Description of the Arteries and Veins. The Nerves come chiefly from the *Costales*, and, by means of these, communicate with the great *Nervi Sympathetici*.

OF THE FORMATION OF THE MILK.

The Antients imagined, that Milk is secreted from the very Blood; but most of the Moderns, with more Reason, think, that it is derived from the Chyle: Nor are there any immediate Vessels, whereby it is conveyed from the thoracic Duct, yet discovered belonging to the Breasts; but is deposited in those Organs by the sanguine Arteries. The Chyle, thus elaborated, is conveyed to the *Vesiculæ Mammæ* somewhat like the uterine *Lactea*. The Vessels are disposed in the same Manner in the Breasts; where the Ducts, rising from the *Vesiculæ*, are called *Vasa Galactifera*; all which meet in seven or eight large Trunks, which terminate in so many Orifices in the Nipples of the Mamma. From each of the said *Vesiculæ* arises a lymphatic Vessel which ascends to the axillary Glands, where all these mamillary Lymphatics terminate. Hence, in all painful Distensions of the Breast from the Milk, &c. the Patient feels a Pain in the *Axillæ*: and hence Obstructions of the axillary Glands, in most Cancers.

In Girls, of about ten or twelve Years of Age, the mammary Lymphatics are very small; so they receive no Fluid but a thin Lymph, which is returned into the Blood by the Way of the axillary Glands, as above; not being spissid enough to remain in the Breasts.

But

But young Women, about the Age of fifteen or sixteen Years, grow not so speedily as before; whence they form superfluous Chyle; which, by Degrees, procures itself a little Passage into their Breasts: Wherefore the small Quantity of it, mixed with the Lymph of the Breasts, renders it more spissid, and less permeable, than before. For which Reason, Part of it is retained in their Breasts, which yield a Humour somewhat like the Milk; which, by its Spissitude, was incapable of circulating in the small Ducts of the axillary Glands. Hence the Breasts then grow considerably, and are termed *Maturæ Viro*.

Next to these are pregnant Women, who, from the Compression of the Uterus, and the Retention of their superfluous Blood, have still larger Breasts, and more Milk, as well in those Organs, as in the Uterus: One providently instituted by Nature to nourish the Infant, whilst in the Womb; the other, in its Turn, to feed it, when born. And this is frequently observed in the Breasts, even a little Time after Conception.

Lastly, Women newly delivered have, for two or three Days, flat, depressed, and empty Breasts, through the Derivation of the Milk along with the Floodings; but, when these are once stopped, the Breasts soon grow turgid, and they contain much more genuine Milk than any of the former: So that, from the Distension of their Breasts, their Sensibility, and the continual Efforts of the Milk, now derived to those Organs, the *Febris Lactea* springs, whence immediately ensue Disorders of the Breasts.

OF THE FEBRIS LACTEA.

This Fever, as well as the milky Abscesses of the Breasts, are Disorders, likewise, reducible to those

those which immediately follow Delivery. This Disorder sometimes happens on the fourth Day after the Birth. It is subject to several Varieties: Some never have it, at least have it very moderately. Its Manner of beginning and ending is also various: It is commonly preceded by and attended with Tension, Swelling and Pain in the Breasts, which Symptoms frequently extend themselves to the Axilla: It generally terminates by abundant Sweats, which are the more copious, as the Fever, cold Fits, or Rigours, were greater. These Rigours happen commonly about the third Day after an irregular Manner; then the above Symptoms appear. The Pain in the Arm-pits is sometimes so violent, that the Patient is obliged to hold up her Hand continually; in which Case, the Fever is generally violent.

Women, after their first Birth, are commonly more subject to this Fever than any other, through the Compactness, and, as it were, Impermeability of the Vessels both of the Matrix and Mammæ; but when these Parts are once sufficiently dilated to receive or exonerate their respective Humours, she suffers little or no Fever: At most, it holds no longer than twenty-four or thirty Hours, in others only six; the Pain and Tumour of the Breasts, &c. vanishing along with it.

Others, on the contrary, especially such as we mentioned before, have an acute Fever, with Redoublements, for four Days. Nor is it only terminated by Sweats, but may be also by Vomiting, or reaching to do it; Restoration of the Lochia, Diarrhœa, &c.

The true Cause or Origin of this Fever is as follows:

We have observed before, of the Vesiculæ Lactææ of the Matrix and Breasts, how, by the Contraction of the former Organ, the Lochia are

stopped; whence the milky Liquor arises in the Breasts, which have a strict Affinity with the Uterus. At the Reflux of this Fluid to the Mammæ, of soft, pendulous, and flaccid, as they were before, they become, by Degrees, tense, painful, and turgid; and that in Proportion to the Quantity of Milk returned into the Blood: Whence the various Degrees of the Fever evidently appear, as also from the Quality of the Milk. For if it be sweet, balsamic, and in a moderate Quantity, it will make no great Impression on the Solids, nor Change in the Blood. Consequently, little or no Fever, nor other Symptoms, will supervene. But if the Milk be abundant, swells the Breasts, stagnates in their Substance, and thereby becomes acid and corrosive, or is naturally acedent in Proportion as it is returned into the Blood; it kindles a Fever, preceded by irregular cold Fits; both being violent, according to the Degree of Acidity, and Quantity of the Milk: For these Rigours never happen if the Milk be not more or less acid; which inspissates the Blood, and produces cold Fits.

The Breasts, during this State, are not much tumified through the Spissitude of the Liquor, whereby they cannot enter the small Vessels of the Mamminæ; whence the Breasts are pendulous and soft, during that Time: But as soon as the Blood is divided and attenuated by the Fever, they begin to swell, and the Fever ends in profuse Sweats. If to the great Quantity of Milk, with the preceding Quality is added a large Quantity of Crudities in the Primæ Viæ and other Emunctories, as we observe frequently in such as eat too much about the Time of their Delivery, or were accustomed to Gluttony, &c. the Fever will not only be so much the more violent, but even putrid, and likewise subject to Exacerbations, &c.

Those

Those Women who suckle, are subject to a Disorder called *Morbus Piliaris*, which is an unequal Tumor of the Breasts, attended with Heat, Tension, and Redness, commonly preceded by shivering or cold Fits; to which succeeds a *Febris Ephemera*, which frequently terminates in thirty-six Hours, and very often gives Leave to Suppuration and Abscess of the Breasts, &c.

This Disorder has received various Names.

Some say that it was called, by *ARISTOTLE*, *Morbus Peloris*; because he imagined that the Nurse swallowed Hair. Others named it *θρομβωσις*, or *θυρωσις*; in Latin, *Caseatio*; and English, Curdling of Milk.

If we consider the Beginning and Progress of this Disorder, we may easily discover, that it takes its Rise from stagnant Milk lodged in the *Vesiculæ Mammæ*: For the Character of the incipient Disorder makes this evident, by the Tension and unequal Tumor of the Breasts; which, in this Circumstance, cannot spring from any other Source than the Milk, which thus obstructs several Clusters, like Bunches of Grapes, of the said *Vesiculæ*; because their common Duct, or *Vas Galactiferum*, through the different Causes, to be immediately explained, cannot exonerate the Milk of these united Receptacles. These Clusters are more or less numerous, according to the Number of the obstructed *Vasa Galactifera*.

That the stagnant Milk is the principal Cause of this Disorder, is also proved by the Diminution or entire Removal of the Evil when this Milk is sucked; nor will any other Remedies be so efficacious for its Cure.

The Causes which inspissate the Milk are,

1. Sudden Cold, in which the Breasts are sometimes unwisely exposed to the Air. 2. But this is still more; viz. the depraved Quality of the Wo-

man's Aliments, and her Indigestion ; whereby a vicious Chyle is formed ; which, by its Mixture with the Blood, &c. inspissates the whole Fluids of the animal Oeconomy. 3. The Change of Diet. Thus a Nurse, accustomed to a slender Diet, by feeding on succulent nutritious Aliments, yields spissid Milk. This is the Reason why some Nurses, after changing their accustomed Manner of Living, as when they come into a Gentleman's Family, or from the Country to Town, frequently their Milk turns bad, though before it was exceeding good.

We may add here an Infinity of other Causes : As when the Nurse neglects to suckle the Child at proper Intervals of Time ; when the Milk remains too long in the Breasts, or the Child happens to be too weak to suck Milk enough ; and it may proceed from the ill State of Health of the Nurse.

For if she be young and healthy, she will, consequently, make more Milk than the Child is able to consume ; so the Remainder will gradually accumulate in the Breasts, and produce Inflammations, Abscesses, Ulcers, &c.

1. Redundant Milk, which so distends the Vesiculæ of the Breasts, that they obstruct and strangle the Orifices of all the adjacent Vasa Absorbentia, which serve, in Resolution, to return the stagnant Humours. This is very frequent in the Febris Lactea and Morbus Piliaris.

2. The Spissitude of the Milk ; whence it cannot circulate in the small Vessels which should absorb it. But however they at any Time receive but its most fluid Particles, the rest remaining in the Vesiculæ, till, by Degrees, it is hardened ; and then forms a Scirrhus, if it does not produce an Inflammation.

3. The

3. The Acrimony of the Milk, where it stimulates the Vessels, excites their convulsive Contraction, gives Room to the Stagnation of the Blood, and to Inflammation.

Now if Resolution be once prevented, and Inflammation formed and continued, that towards the End the Symptoms of Inflammation become more intense, as the Tension, Pain, Heat, Redness, &c. it denotes a Rarefaction of the included Humours, and that Suppuration is at Hand. The Swelling of the Breasts, to this Pitch, so compress the large arterial Branches, that the Person sensibly feels their pulsative Motion: The Suppuration being formed, the Rarefaction of the Matter is diminished, the tumefied Part becomes flaccid, and subsides, and all the forementioned Symptoms cease.

But we are to observe, that, of all Suppurations, none are so slow, and imperceptible, as that of the milky Tumors, or such as are formed of a Mixture of Blood and Milk; for this Matter is so sweet and balsamic, that it hardly irritates the Vessels; and, for want of a corrosive Acrimony, it is not subject to gain far into the adjacent Parts: The Pus is, moreover, extremely white. But in purely sanguine Inflammations, the stagnant Humour is so charged with Salts, that its Progress is speedier, it stimulates the Vessels, excites their Oscillations, has an acrid Quality, fuses at a great Distance, and is of a grey Colour; wherefore milky Abscesses are much more supportable: So that some Patients bear them, for a long Time, without any manifest Danger; whilst the Abscesses of sanguine Inflammations, besides the above Symptoms, frequently kill the Patients; likewise by slow Fevers, and other Symptoms arising from the Absorption of the corrosive Pus. Yet, when the milky Pus remains a long Time included in its

Cyſta, it diſtends its Capſula in ſeveral Apices of the Breaſt, renders it thinner, and raiſes a great many Elevations.

This Diſorder is rarely mortal; but it is very painful, through the Senſibility of the membranous Texture of the Breasts: It is alſo very tedious, and difficult to be cured; becauſe the enſuing Ulcer is commonly ſordid, and can never be well deterged, through the Spongineſs of the Breaſt.

In ſhort, it may be very dangerous if it terminates in a Scirrhus, or Cancer, through the Induration of the ſtagnant Matter. Dr. ASTRUC.

VARIOUS CONJECTURES ON THE FORMATION OF THE MILK, &c.

Nature has not freed the Breasts from her Luſus. Women generally have but two; but BLASIVS has remarked three in one Woman; WALÆRUS and BORRICHIUS obſerved the ſame. THOMAS BARTHOLINE gives an Account of a Woman who had four; another Anatomist has made the ſame Obſervation. As for their Bulk, they are monſtrous in ſome Countries: At the Cape of Good Hope the Women have their Breasts ſo long, that, it is ſaid, they throw them over their Shoulders.

After having ſeen the Structure of the Breasts, we muſt mention ſomething of their Uſe; which is, to ſeparate the Milk from the Maſs of Blood.

The firſt Queſtion to be aſked is, What the Nature of the Milk (which comes from the Breaſt) is?

1. Here is what is diſcovered by the Help of the Microſcope. I feign would examine, ſays LEWENHOECK, what Matter the Blood is formed from; and I obſerved, that it is compoſed of ſmall red Globules that ſwim in a clear Fluid: I alſo diſcovered, that the Milk was nothing but a Cluster of ſmall Globules that ſwam in a diaphanous

nous Fluid; but the Globules of the Blood differ from those of Milk in their being of an equal Bigness, which those of the Milk are not; some being small, others large, of an irregular and somewhat globular Figure.

By the Analysis we thought to discover the Nature of Milk; but we by that shall never gain the Point. Fire changes Bodies, since it discomposes them: It cannot, therefore, give us the true Principles of Bodies.

Those who reason on the Nature of Milk, according to the Analysis, have no more Reason than those who would know the natural State of Pebbles by Lime.

It will then be asked, Whether the Milk is an Acid, or an Alkali? It is neither one, nor the other. The acid Salts that are separated from the Aliments are insinuated in the animal and vegetable Earths, or rather in their Alkalies. In this Mixture it cannot have an Acid or Alkali; a middling Salt will be only produced: Add to this, that Oil changes these Salts greatly.

Milk is nothing but a true Chyle, but has a less Serum. It is somewhat more triturated by the Heat of the Blood, Motion of the Heart, and Resort of the Vessels. Cheese, Cream, and Butter, may be made of it. It coagulates not on the Fire, as the Serum of Blood; that only which exhales leaves a thickish Substance at the Bottom.

1. It has a less Serum; because that which is found in the Chyle divides into the whole Mass of Blood: It must therefore have but a Part of it in the Milk.

2. The Milk was more triturated, since it passed the Heart, and most of the Vessels.

3. We may make Cheese of it, which we cannot do in the Chyle; because the Oil is not separated

rated enough from the Phlegm, and mixed with the Matter that forms the Basis of the Salt of the Blood.

4. It coagulates not as the Serum of the Blood; because that has passed through many secretory Ducts, when it has passed through them. The most aqueous Part flows into the Filtres and lymphatic Vessels; the oily Part, therefore, gathers in greater Quantity; than it mixes not so well with the Water. If exposed on the Fire, what happens? The Particles of Fire act on these oily Parts concentrated; their Action expresses the Water that remained there: The oily Parts, therefore, must gather together, and form a more solid Whole. The same happens not to the Chyle; because the Oil was not concentrated enough in passing through the Strainers and natural Heat.

5. Milk alkalises in Fevers; it changes Colour. It has been sometimes observed to become yellow from Night till the next Day: This Colour is given the Milk when we boil it with Alkalies. The Heat which is excited in the Blood by Fevers produces the same Effect. Thus we see that animal Substances are less proper to afford good Milk than Vegetables: For the Parts of Animals are more alkalised and disposed to Putrefaction.

The second Question to be examined is, Whether the Milk comes from the Blood immediately, or whether it be nothing but a Chyle brought to the Breasts by particular Ways? The Antients said, that it proceeded, in some measure, from the menstrual Blood. CORINGIUS advanced, that it was produced by the Blood which became not perfectly red. BARBATUS believed, that it proceeded from the Serum of the Blood. MALPIGHI said, that Fat could produce Milk. ENTIUS, DEUSINGIUS, and EVERARD, form it from the Chyle.

WHARTON.

WHARTON is of the same Opinion; but he adds the nervous Juice to it.

The Antients knew but the Arteries and Veins, and therefore sought for no other Vessels to carry the Milk to the Breasts. The Knowledge which they wanted, says Needham, hindered them from erring; but, after ASSELLIUS's Discovery of the lacteal Veins, they began to seek for Canals which might immediately carry the Chyle into the Breasts. EVERARD says, that, having dissected a Bitch that was with Young, and gave suck, he observed chylous Canals which crept by the Muscles of the Abdomen upon the Fat, and were inserted in the glandular Texture of the Breasts; but this Discovery was not confirmed by any Anatomist: There is therefore more Appearance that there are no milky Canals, and that the Chyle comes from the Blood in the Breasts. The Ducts are not necessary; for the Chyle may be carried through the sanguinary Vessels.

1. We have seen Examples which prove that the Milk may issue out through an infinite Number of Places; as the Thigh, &c. It is certain, therefore, that nothing can carry that milky Juice there but the Blood.

2. Injections prove, that there is a continued Way from the Arteries to the milky Ducts. This Continuation of Canals can be of no other Use than the discharging the Arteries.

3. What could be objected is, that the Blood might change the Chyle: But here follows a solid Answer of LOWER.

The Chyle, says he, mixed with the Blood, leaves not its Whiteness immediately: On the contrary, it circulates a long Time with the Blood before it loses its Colour. We have nothing else to do but to open the Vein of an Animal four or five Hours after it has eat much, and we shall see

a great deal of Chyle swimming on the coagulated Blood: This Chyle is like the Milk. I have made the same Experiment on Men who were let Blood after a full Dinner or Breakfast: The Vessel rather seemed full of Milk than Blood.

MANGET observed a perfect clear Chyle come from the Nose of a Man who had lost a great Quantity of Blood in an Hæmorrhage.

The third Question is,

How the Milk filtrates, and is sucked by the Child? The Blood, filled with Chyle, is carried into the Arteries of the Breast: By the Mechanism of Secretions, which we have already explained, the Blood is too thick to pass through the secretory Ducts; but the Milk, whose Mollicles are not so thick, according to LEWENHOECK, immediately insinuate there: From these Strainers issue out Lymphatics; by the Pressure of the Blood and Membranes the aqueous Part is insinuated, so that the Milk has less Phlegm; this Milk, carried into the Follicles and Ducts, is propelled by the Blood found in the spongy Texture with which the milky Canals are environed, and of which the Nipple is formed: The Ducts which receive the filtrated Milk are very numerous, and grow wider towards their middle Part; they can therefore contain a large Quantity of Fluid: When the Distension of the Vessels will surmount the Oppression of the Nipple, the Milk will flow voluntarily; the Mechanism by which the Infant causes the Milk to come to it.

STENO, in his Treatise on the Glands, says, that Nature gave Nerves to the parotid Glands (which very much resemble the glandular Bodies of the Breasts): Thus, according to the Action of Imagination and Will, the Saliva may flow from its Reservoirs. When the Nerves are about to act, says he, they streighten the Vessels through which
the

the Saliva might flow, and oblige it to issue out.

What STENO says of the Parotids, on the Subject of Nerves, may be said of the Breasts. They are covered by an infinite Number of nervous Fibres which form Papillæ on the Nipples, as observed by RUYSEN; these Papillæ, being irritated by sucking, streighten the capillary Vessels that retake the Blood from the spongy Texture; thus the Blood, which is always propelled through the Arteries, accumulates there, and presses the milky Tubes; which, by that Pressure, pour out the Milk.

There is still another Cause that obliges the Milk to issue out. The Infant pumps the Air in sucking; thus the Milk ought to issue out with an Impetuosity proportionable to the Force with which the Air is pumped. If, by a sudden Inspiration, all the Space of the Mouth were found void of Air, in such a Manner that that Fluid could not enter there any other Way; the Milk would run with great Force; as we may see, when we suck a Fluid with a glass Tube: Then the Lacteals are extremely pressed by their Number, at the Places where their Inosculations are found with the external Ducts, and by that Pressure obstruct the Passage of the Milk; these Vessels, I say, compressed by the Force of the external Air, throw the Milk into the Infant's Mouth.

The fourth Question to be asked is, Why Men have not Breasts? We may answer to this, That they are of no Use to them. Nature immediately formed the Parts that were necessary for the Conservation of the Species: Though these Parts are unusual in one Sex, still that Sex is not entirely deprived of them, unless that Deprivation be a necessary Consequence of the Structure that makes the Sexes to differ,

If what Travellers say, that Men nourish their own Children, be true, we could not then say, that the Breasts were entirely useless.

VENETIUS gives us an Example of a Man whose Breasts contained a vast Quantity of Milk. THEOPHILUS BONETIUS, in his Sepulchretum Anatomicum, p. 163. gives us many of the like Stories. The Men, of whom these Authors speak, might, without doubt, nourish an Infant, if their Breasts were sucked. But it will be said, Why have not Men Milk, as well as Women?

NATHANIEL HIGHMORE answers, That the glandular Bodies which are found in the Breasts of Women are not found in those of Men, or that they there appear dry. The Breasts, says he, are very prominent in fat and effeminate Men; but their Figure and Substance distinguish them from those of Women.

ARISTOTLE, with Reason, says, that the Substance of the Breasts of Women is fungous; and that it was depressed, and dry, in those of Men.

These Reasons of ARISTOTLE and HIGHMORE do not reach to the primary Cause: It would be necessary that they explain why the Breasts are more dry in Men, than in Women.

1. In Infants, of either Sex, the Breasts are very much inflated, and generally contain some Milk. It must be so, since the Organs are the same; and that there is no more Transpiration on one Side than on the other, while the Fœtus is in Utero, and during its Infancy.

2. As soon as young Women are arrived to a certain Age, and that they have their Menfes, then the Vessels of the Breast, which are very flexible, dilate: From these Vessels there always passes a Fluid into the lacteal Follicles; the turgid Arteries alone cannot produce the Tumor that rises there, and this Fluid repasses in the Veins or Arteries.

teries. Perhaps we may sustain, that it is in the Arteries it runs back again: For these Canals, being compressed by the Texture of the Breasts, which is very firm, and the Resort of the small Vessels, the Fluid may return in the Arteries: But it is probable, also, that there may be Canals to bring them back into the Veins. The Swelling we have been speaking of, happens in Proportion as young Women approach the Age of thirteen or fourteen Years: Then it is perceived, especially some Days before the menstrual Flux. The Blood, which fills the uterine Vessels in an extraordinary Manner, hinders that which follows from entering the Blood which flows in greater Quantity into the Arteries, which from the Abdomen communicates with the Breasts, and hence the Breasts swell. As soon as the secretory Ducts of the Uterus begin to open, the Blood passes no more in so great a Quantity through the Arteries communicating with the Breasts; the Blood, which swelled the Breasts, circulates by Degrees, and the Fluid separated from it, pressed by the mammillary Texture, re-enters the Course of Circulation by Degrees; the Breasts must then be evacuated, as we have already said.

3. Thus we see, that the same Reason which proves no menstrual Flux in Man, proves, that the Milk ought not to filtrate in their Breasts. As they have no Plethora, the mammillary Vessels, which are never swelled, do not dilate: On the contrary, as they fortify and harden, the Follicles and milky Ducts acquire a Hardness, because they are membranous; and thus the Blood would not be able to separate the Milk, when there should even at last happen a Plethora, as we often see by periodic Fluxes, which are performed through the hæmorrhoidal Vessels.

4. We may, nevertheless, see Men, in whom a Plethora, large mamillary Canals, a Pressure, or Sucking, would produce Milk. All this depends upon the Dilatation of the Canals.

The fifth Question worthy our Notice is, Why Women, after Child-bed, have Milk? The Mechanism only of the Motion of the Parts in Child-bed Women may answer this Question. Those who were not of the same Opinion have said nothing but Absurdities.

DEUSINGIUS believed, that the menstrual Blood contracted a certain Quality which rarefies the Blood, and there forms a Disposition to change into Milk. He adds, that the Fœtus, compressing the Pancreas and Stomach, propels the Chyle towards the Breasts. But this last Opinion would prove, that the Milk should be formed during the Pregnancy, and terminate after Delivery.

DIEMERBROECK, not satisfied with that Explanation, says, it is nothing but Imagination that determines the Milk towards the Breasts. He brings many Examples to prove that Opinion: But there is more Imagination in the Opinion of that Anatomist, than in the Cause that gives Child-bed Women their Milk. Likely, according to him, that Goats, which have Milk, though they have not been with Young, have a very great Force of Imagination; since they have it long before Women.

BAYLE, Professor of Philosophy at Tholouse, is every-where for Fermentations. He attributes the Origin of Milk to Fermentation. I will not enter into the whole Explication, which is unworthy of so great a Man. We may ask his Followers,

1. Whence proceeds this Fermentation?

2. How it is produced in the Breasts?

3. What is its Nature?

If they have but Possibilities, or Imaginations. they are not worthy to be heard.

To comprehend the Cause that propels the Milk into the Breasts after Child-bed, we must recal,

1. That the Milk proceeds from the Chyle.
2. That the Vessels of the Uterus are extremely dilated during Pregnancy.
3. That the Uterus contracts immediately after Delivery.

4. That there passed a great Quantity of Chyle, or milky Matter, into the Fœtus.

From the third Proposition, 1. It follows, That the Blood being no more able to enter, in so great a Quantity, into the descending Aorta, will mount, in greater Quantities, in the ascending Arteries; and, consequently, those Arteries which come from the Subclavian and Axilian into the Breasts, will be more turgid.

2. It follows, from that same Proposition, that the Blood which enters into the descending Aorta, being no longer able to be insinuated, in so great a Quantity, into the Uterus, will fill the epigastric Arteries more which communicate with the Breasts: The Breasts then must be more inflated, on both Sides, after Delivery.

3. From the fourth Proposition it follows, That the superfluous Chyle of the Nourishment of the Mother, which passed in the Fœtus, must divide, to flow into other Vessels; and, consequently, be carried to the Breasts. At the first Circulation that will be performed, there will come one Part; at the second another, &c. and at five or six Hours after eating, the Chyle is not yet changed into Blood: The numerous Circulations, which will be performed during that Time, will there carry the greatest Part of that Chyle which would have passed in the Fœtus, if it were still in the Womb. Whilst the Chyle is thus carried to the Breasts, the Follicles fill in an extraordinary Manner, and the inflated Ducts are very much com-

compressed; and at the Place where they inosculate this Pressure hinders the Milk from overflowing: The Ducts, which were not, as yet, open, contribute also, by their streight Cavity, to hinder this overflowing; but, as soon as the Breasts are sucked, 1. The external Ducts dilate. 2. The Cylinders of Milk, which are in the internal Ducts, are contiguous to the Cylinders that entered the Externals: The Milk, therefore, which flowed not before, will spout out, after we have once sucked those Ducts which were empty of Milk; by the same Reason that the Urethra is sometimes empty of Urine through the too great Dilatation of the Bladder; which, being too much inflated, thrusts its Neck again into its Cavity, as we have before explained it. 3. By the same Reason that Milk is filtrated in the Breasts of Lying-in Women, it may also be filtrated in those of Virgins whose Menstrua are suppressed. For the Blood, not being able either to circulate freely, or issue out thro' the Womb, will be propelled in the Breasts, as it often happens. Hence we see, that this may happen to Women in Years, whose Menses are at an End. Nevertheless, as the Fibres are dried by Age, this will not happen in aged Women, whose Parts are dry.

The sixth Question to be asked is, Whence arise the different Properties observed in Milk?

1. The Milk grows sour, which happens not to other Fluids that arise from the Blood. This Sourness proceeds from nothing but the Acids separating from the alkaline Earth and their Oil, which happens not to the other Fluids, because the Heat has more strongly united their Principles, and disposed them more to Alkali than Acid.

2. Milk has the Virtue, Taste, and Smell, of the Aliments; because the Particles of Matter, with which we are nourished, pass into the Blood

without being discomposed, and enter into the Breasts without having suffered hardly any Change; as appears by the Experiment of LOWER.

Thus if the Aliment be good, the Milk will be good; if it is bad, the Milk will be so too; especially if we have fasted long: For then it cannot be mixed with any other Matter that might give it some Alteration.

Some Hours after Meals, as it has circulated, it will be proper to form good Milk: If it was too acid, the Heat will then have changed it, and will be more disposed to become alkali; if it be too much alkalised, the alkaline or too much heated Part will precipitate by the Urine, because it becomes more viscous, as we may see by the Urine. If a Nurse fasts twenty four Hours, the Chyle will alkalise, and thus will form a yellow saltish Milk, disposed to putrefy. *Phys. Essays.*

OBSERVATIONS.

It is a Matter of Dispute, among some Surgeons, Whether cancerous Tumors should ever be extirpated, or not? Though it is certain, none of these ever were cured without; and, being extirpated, there have been many.

The Objection against Extirpation is this: That the Operation often provokes the Part, which otherwise might lie quiet. But I do not think this is true. In desperate Cases, where we cannot extirpate, we find the best Remedy is plentiful Bleeding (which also is Nature's last Resort), gentle constant Evacuations by Stool, and a Vegetable Diet. And though Physic never cures while the Tumor remains; yet, after Extirpation, it is highly useful, and even the worst Constitutions have sometimes been brought to their primitive State.

An eminent Surgeon in the City, having a Patient with a cancerated Breast, extremely large, and so much ulcerated, that the Stench of it was insupportable; she insisted upon the Extirpation, against all Advice, with no other Hopes but to be delivered from the offensive Smell. Some Time after the Operation, the Wound looking extremely sordid, he sprinkled it all over with red Mercury Precipitate, which put the Patient into a high Salivation; upon which, the Breast grew clean, and healed; the Patient recovered, and, contrary to all Expectation, lived many Years in good Health.

From this Accident I learned the Usefulness of salivating after extirpating cancerous Tumors, though nothing is more hurtful before.

In the Extirpation of a Breast, and all other Tumors, as much Skin as is possible should be saved; for the Loss of a great deal of Skin is enough to make an incurable Ulcer in the most healthful Body, and much more so in a bad Constitution. CHESELDEN'S Anatomy.





LECTURE XXI.

Of the PLEURA, HEART, and its Appendages.

THE Pleura is a Membrane which adheres closely to the internal Surface of the Ribs, Sternum, the Intercoastal, Subcoastal, Sternocostal Muscles, and to the convex Surface of the Diaphragm. It is of a very compact Texture, somewhat like the Peritonæum; being furnished with Plenty of sanguineous Vessels; and likewise in that it is composed of an internal membranous Lamina, and a cellular Substance on the external Side, which is a Production or Continuation of the Lamina.

The cellular Portion surrounds the internal Surface of the Thorax, but the membranous Portion is disposed in a different Manner. Each Side of the Thorax has its particular Pleura entirely distinct from the other, and forming, as it were, two great Bladders, situated laterally, with respect to each other, in the great Cavity of the Thorax, in such a Manner, as to form a double Septum, or Partition, running between the Vertebrae and the Sternum; their other Sides adhering to the Ribs and Diaphragm.

This particular Duplication of the two Pleuræ is named Mediastinum: The two Laminæ, of

which it is composed, are closely united together near the Sternum and Vertebrae; but in the Middle, towards the inferior Portion of the anterior Part, they are separated by the Pericardium and Heart. A little posteriorly they are divided, in a tubular Form, by the Oesophagus, which is invested by it; and in the posterior Part a triangular Space is left between the Vertebrae and two Pleurae, from the superior to the inferior, which is filled chiefly by the Aorta.

Before the Heart, from the Pericardium to the Sternum, the two Laminæ adhere very closely, and there the Mediastinum is transparent, except for a small Space near the superior Part, where the Thymus is situated; so that, in this Place, there is naturally no Interstice or particular Cavity. The apparent Separation is owing entirely to the common Method of raising the Sternum, as was plainly demonstrated by BARTHOLINUS, in his Treatise of the Diaphragm published at Paris in 1676.

The Mediastinum does not commonly terminate along the Middle of the internal Side of the Sternum, as the common Opinion has been. WINSLOW has demonstrated (in the Year 1715, to

LIEUTAUD observes, that the Pleura does not always lie more on the left Side; and says, that sometimes it lies on the right, sometimes it divides the Thorax exactly in the Middle.

HEISTER maintains, that there is a Space left between the two Pleurae, and it is imaginary. Wherefore, to support his Argument, he relates, that many Authors of Credit give us Instances of Abscesses formed therein; and MAIER (in his Colleg. Pract.) assumes, that he has frequently found a serous Humour in it.

But the serous Humour, or Pus, that I found in Children and Adults, under the Sternum, as well as between the Pleura and Ribs, is no Argument that, in the natural State, there is a Division. It is very well known, that, in an inflammatory Fever, or Pleurisy, the cellular Membrane of the Thorax is sometimes so much inflamed, that it is more than Half an Inch thick, full of Serum, and which turns into Pus. However, the cellular Membrane of the Pleura is more loose under the Sternum, than towards the Ribs.

the Academy of Sciences), that superiorly downwards it inclines towards the left Side; and that if, before the Thorax is opened, a sharp Instrument be run through the Middle of the Sternum, there will be almost the Breadth of a Finger between the Instrument and the Mediastinum; provided that the Sternum remain in its natural Situation, and the Cartilages of the Ribs be cut at the Distance of an Inch from it, on each Side.

From all this we see, not only that the Thorax is divided into two Cavities entirely separated from each other, by a middle Septum, without any Communication; but also that, by the Obliquity of this Partition, the right Cavity is greater than the left: And from hence we may judge of the Uncertainty of trepanning the Sternum, which the Antients have recommended, in some Cases.

The cellular Portion of the Pleura connects the membranous Portion to the Sternum, Ribs, and Muscles; to the Diaphragm, Pericardium, Thy-mus, and Vessels; and, in a Word, to whatever lies near the convex Side of the membranous Portions of the Pleura. It likewise insinuates itself between the Laminæ of the Duplicature of which the Mediastinum is formed, and unites them together: It even penetrates the Muscles, and communicates with the cellular Substance in their Interstices, all the way to the Membrana Adiposa on the external convex Side of the Thorax. In this the Pleura resembles the Peritonæum.

The Surface of the Pleura, turned to the Cavities of the Breast, is continually moistened by a lymphatic Serosity which transudes through its Pores, or exhaling Arteries*.

* This Fluid was thought, by some Anatomists, to be secreted by imperceptible Glands; but the Existence of them has not been hitherto demonstrated. The same was likewise observed in the Peritonæum.

The Arteries and Veins of the Pleura are chiefly Ramifications of the Intercostals, which are very numerous, and, for the most part, very small. The Mammariæ Internæ and Diaphragmaticæ likewise send Branches to it, which communicate very frequently with those of the Intercostals.

The Mediastinum has particular Arteries and Veins, which are commonly Branches of the Subclaviæ. The Mammæ Internæ send likewise anterior Ramifications, the Diaphragmaticæ to the inferior, and the Intercostales and Oesophagææ to the posterior Part.

The Nerves are Ramifications of the true Intercostales, called also Costales and Dorsales. Near the Vertebrae they communicate with the great sympathetic Nerves, improperly called Intercostales, and but very little with the middle Sympathetici, or those of the eighth Pair.

The Pleura serves, in general, for an internal Integument to the Cavity of the Thorax; the Mediastinum cuts off all Communication between the two Cavities, and hinders one Lung from pressing on the other when we lie on one Side; it likewise forms Receptacles for the Heart, Pericardium, Oesophagus, &c. and is continued over the Lungs as the Peritonæum invests the Viscera.

Before we leave the Pleura, it must be observed, that these Portions of it, which adhere immediately to the Ribs, may be looked upon as the Periosteum of their internal Sides. This Adhesion keeps the Pleura stretched, and hinders it from slipping, or giving way: It likewise renders this Membrane extremely sensible of the least Separation caused by a coagulated Lympha, or accumulated Blood; the nervous Filaments being likewise, in this Case, very much compressed, in Inspiration, by the swelling of the intercostal Muscles.

The THYMUS is an oblong glandular Body, round on the superior Part, and divided below into

two or three Lobes; of which, that towards the Left is the longest. In the Fœtus it is of a pretty large Size, less in Children, and very little in aged Persons. In Children it is of a white Colour, sometimes mixed with red; but in an advanced Age its Colour is generally dark.

The greatest Part of the Thymus lies between the Duplicature of the superior and anterior Portion of the Mediastinum and the great Vessels of the Heart, from whence it reaches a little higher than the Tops of the two Pleuræ, so that some Part of it is out of the Cavity of the Thorax. In Fœtuses and Children it lies as much without the Thorax as within it.

Its particular internal Structure and Secretions are not, as yet, sufficiently known to determine its Uses; which, however, seem to be designed more for the Fœtus, than for Adults. It has Vessels which are called Arteriæ and Venæ Thymicæ.

CONJECTURES ON THE USE OF THE THYMUS GLAND.

DIONIS thought that he had discovered the true Use of this Gland, by saying, that its Use in the Fœtus was, to secrete the chylous and lacteous Liquors which were poured out into the subclavian Vein, and from thence into the thoracic Duct.

This Reasoning seems plausible enough: But as the excretory Ducts have not yet been discovered, therefore we must confess, that we are, as yet, as ignorant of its true Use, as before.

BELLINGER is of Opinion, that this Gland prepares a nutritious Fluid in the Fœtus, and conveys it, by particular Ducts, to its Mouth*. But we find, that neither himself, nor any Body

* Vid. Tract. de Nutritio.

else, have ever been able to demonstrate these pretended Ducts.

HEISTER says, possibly the Thymus Gland serves to secrete the Lymph, which it discharges into the thoracic Duct, for the Dilution of the Blood; as the Mesentery and pancreatic Glands do in respect to the Chyle.

On this Supposition, its Use must, consequently, be greater in the Fœtus than after Birth: Because the Want of Respiration may well be supposed to subject the Blood to be thicker, and to need Dilution more than afterwards; as nothing tends to attenuate the Blood so much as Respiration.

It has been found indurated by a Scirrhus, and very large in a Boy about thirteen Years of Age, who died of a hectic Fever.

Dr. TYSON imagined that this Gland served as a Reservoir of Lympha, to dilute the Chyle of the thoracic Duct of the Fœtus, as its Stomach is continually supplied by the Liquor Amnii (as he thought the Fœtus was nourished by the Mouth), which swelled the thoracic Duct by this chylous Liquor; because the Blood, which the Fœtus receives from the Uterus, fills up and hinders the Chyle from entering the subclavian Vein.

The same Author observed, that it cannot be doubted but there are Valves in the lymphatic Vessels of the Thymus, which have Communication with the subclavian Vein, as he assures us, by injecting this Gland, he has found so.

The HEART *

Is a muscular Body situated in the Cavity of the Thorax on the anterior Part of the Diaphragm,
be-

* Cor à currendo nomen desumpsisse videtur, unde etiam Belgis (quod alioqui Cervum significat), appellatur HART, vel HERT, quia sicut illa Bestia præ cæteris Animalibus, ita Cor præ cæteris Corporis par-

between the two Laminæ of the Mediastinum. It is, in some measure, of a conical Figure, flattened on the Sides, round at Top, and oval at the Basis. Accordingly, we consider in the Heart the Basis, Apex, two Margins, and two Sides; one of which is generally flat, the other more convex.

Besides the muscular Substance that chiefly forms what we call the Heart, its Basis is accompanied by two Appendices called Auriculæ, and by large Blood Vessels; and all these are included in a membranous Capsula named Pericardium.

It is concave, and divided by a Septum that runs between the Margins into two Cavities called Ventriculi, one of which is thick and solid, the other thin and soft. This latter is generally termed the right Ventricle, the other the left; though, in their natural Situation, the right Ventricle is placed more anteriorly than the left.

Each Ventricle opens at its Basis by two Orifices, one of which answers to the Auricles, the other to the Orifice of a large Artery; and, accordingly, one of them may be termed the auricular Orifice, the other the arterial. The right Ventricle opens into the right Auricle, and into the Trunk of the pulmonary Artery; the left into the left Auricle, and into the Organ of the Aorta. At the Margins of these Orifices are found several

partibus, Cursu & Motu valet. Quod tamen Belgicum Anglicem nomen etiam derivari posse videtur ab HARDEN, quod durationem, aut ab HARD, quod duritiem significat, vel quia ejus Motus durat, per totum Vitæ Tempus, vel quia substantiæ duritiæ Musculos aliaque Parenchymata superat.

RIOLANUS nomen deducit à Græco κῆρ, contracto ex καρ, quod à κέω, uro, derivatur, quia ex eo Ignis nostri Corporis procedit: Atque sic etiam Belgis Hert, ab Heert; quod focum significari posset.

MENETIUS à καρδανος, vibro, concutio, derivat. CHRYSIPPUS ἐπὶ τῆς καρδίας, seu καρδίας, à robori, vel à καρῖω, robustum imperium habeo, quoniam validissimas Actiones edit, & quasi Imperium in reliquis totius Corporis partes habet.

moveable Pelliculæ called Valvulæ; of which some are turned interiorly towards the Cavity of the Ventricle, named Triglochines, or Tricuspidæ; others are turned towards the great Vessels, called Semi-lunares, or Sigmoidales. The Valvulæ Tricuspidæ of the left Ventricle are likewise termed Mitrales.

The internal Surface of the Ventricle is very uneven, many Eminences and Cavities being observable therein. The most considerable Eminences are thick fleshy Productions called Columnæ. To the Extremities of these Pillars are fastened several tendinous Cords, the other Ends of which are joined to the Valvulæ Tricuspidæ. There are likewise other small short tendinous Ligaments along both Margins of the Septum between the Ventricle: These small Ligaments lie in an obliquely transverse Situation, and form a reticular Texture at different Distances.

The Cavities of the internal Surface of the Ventricle are small deep Fossulæ or Lacunæ placed very near each other, with small prominent Interstices between them: The greatest Part of these Lacunæ are Orifices of the venal Ducts.

The fleshy or muscular Fibres of which the Heart is composed, are disposed in a very singular Manner, especially those of the right or anterior Ventricle; being either bent into Curvatures, or folded into Angles.

The Fibres which are folded into Angles are longer than those which are only bent into Curvatures; the Middle of these Curvatures, and the Angles of the Folds, are turned towards the Apex of the Heart, and the Extremities of the Fibres towards the Basis: These Fibres differ not only in Length, but in their Directions, which are very oblique in all, but much more so in the long or folded

folded Fibres, than in the short ones, which are simply bent.

It is commonly said, that this Obliquity represents the Figure 8 : But the Comparison is very false : and can only agree to some bad Figures drawn by Persons ignorant of the Laws of Perspective.

All these Fibres, Regard being had to their different Obliquity and Length, are disposed in such a Manner, as that the longest form partly the most external Strata on the convex Side of the Heart, and partly the most internal on the concave Side ; the Middle of the Curvatures and the Angles meeting obliquely and successively to form the Apex.

The Fibres situated within these long ones, grow gradually shorter and narrower all the way to the Basis of the Heart, where they are very short, and but little incurvated. By this Disposition, the Sides of the Ventricles are very thin near the Apex of the Heart, and very thick towards the Basis.

Each Ventricle is composed of its proper distinct Fibres, but the left has many more than the right. Where the two Ventricles are joined, they form a Septum that belongs equally to both.

There is this likewise peculiar to the left Ventricle ; that the Fibres which form the internal Stratum of its concave Side form the external Stratum of the whole convex Side of the Heart, which, consequently, is common to both Ventricles ; so that, by carefully unravelling all the Fibres of the Heart, we find it to be composed of two Capsulæ contained in a third.

The anterior or right Ventricle is larger than the posterior or left, as was well observed by the Antients, and clearly demonstrated by HELVETIUS.

They

They are both nearly of the same Length in Men, and in some Subjects they end exteriorly in a kind of double Apex.

All the Fibres are not directed the same Way, though they are all more or less oblique: For some end towards the right, others towards the left; some anteriorly, others posteriorly, and others in the intermediate Places. So that, in unravelling them, we find, that they cross each other gradually, sometimes according to the Length of the Heart, and sometimes according to its Breadth.

The Tubes that cross each other transversely, are much more numerous than those that cross longitudinally; which ought to be taken Notice of, that we may rectify the false Notions that have been entertained concerning the Motion of the Heart: Namely, that it is performed by a Contorsion, or Twisting, like that of a Screw; or that the Heart is shortened in the Time of Contraction, and lengthened in Dilatation.

The Fibres that compose the internal or concave Surface of the Ventricles, do not all reach to the Basis; some of them running into the Cavity, and there forming the muscular Columnæ, to which the loose floating Portion of the tricuspidal Valves is fastened by tendinous Ligaments.

Besides these musculous Pillars, the internal Fibres form a great many Eminences and Depressions, which not only render the internal Surface of the Ventricles uneven, but give it a great Extent within a small Compass. Some of these Depressions are the Orifices of the venal Ducts found in the Substance of the Ventricles. The Circumferences of the great Openings at the Basis of the Heart are tendinous, and may be looked upon as the common Tendon of all the musculous Fibres of which the Ventricles are composed.

The Valves at the Orifices of the Ventricles are of two Kinds: One Kind allows the Blood to enter the Heart, and hinders its Egress the same Way; the other allows the Blood to go out of the Heart, but hinders it from returning. The Valves of the first Kind terminate the Auriculæ, and those of the second lie in the Openings of the great Arteries. The first are called Semi-lunar or Sigmoidal Valves, the others Triglochines, Tricuspidal, or Mitral.

The Tricuspidal Valves of the right Ventricle are fixed to its auricular Orifice, and turned internally towards the Cavity of the Ventricle. They are three triangular Productions, very smooth on that Side which is turned towards the Auricle, and on that next to the Cavity of the Ventricle they have several membranous and tendinous Expansions; and their Margins are indented. The Valves of the auricular Orifice of the left Ventricle are of the same Shape and Structure, but they are only two in Number; and, from some small Resemblance to a Mitre, they have been named Mitrales*.

These five Valves are very thin, and fastened, by several tendinous Ligaments, to the musculous Columnæ of the Ventricles. The Ligaments of each Valve are fixed to two Columnæ; and between these Valves there are other small ones of the same Figure. They may all be termed Valvulæ Tricuspidæ, Auriculares, or Venosæ Cordis.

The semi-lunar Valves are six in Number, three belonging to each Ventricle, situated at the Orifices of the great Arteries; and they may be properly enough named Valvulæ Arteriales: Their concave Sides are turned towards the Cavity of the

* LIEUTAUD says that there are no such Valves, except they be cut thus by the Dissector. *Essais Anatomiq. Articl. vi.*

Arteries, and their convex Sides approach each other. In examining them with a Microscope, we find musculous Fibres lying in the Duplication of the Membranes which they are composed of.

They are truly semi-lunar, or in Form of a Crescent, on that Side by which they adhere; but their loose Margins are of a different Figure, each of them representing two small Crescents, the two Extremities of which meet at the Middle of this Margin, and there form a kind of small Papilla.

The great Artery that arises from the left Ventricle is named Aorta. As its Egress turns a little towards the Right, and then bends obliquely posteriorly to form what is called Aorta Descendens. From about the Middle of the convex Side of this Curvature three great Branches arise, that furnish an infinite Number of Ramifications to the Head and superior Extremities; as the descending Aorta does, in the same Manner, to the Thorax, Abdomen, and inferior Extremities.

The Trunk of the Artery that arises from the right Ventricle, is called Arteria Pulmonaris: This Trunk, as it is naturally situated in the Thorax, runs, first of all, directly superiorly for a small Space, then divides laterally into two principal Branches, one for each Lung; that which goes to the right Lung being the longest.

The Auricles are muscular Capsulæ situated at the Basis of the Heart, one towards the right Ventricle, the other towards the left, and joined together by an internal Septum and external communicating Fibres, much in the same Manner with the Ventricles; one of them being named the right Auricle, the other the left. They are very uneven internally, but smoother externally, and terminate in a narrow, flat, indented Margin, representing a Cock's Comb, or, in some measure, the Ear of a Dog; and, for that Reason, a famous

Anatomist of Leyden would fain have distinguished this Margin by the particular Name of Auricle, calling the rest the Capsula. They open into those Orifices of each Ventricle, which WINSLOW names auricular Orifices; and they are tendinous at their Opening, in the same Manner as the Ventricles.

The right Auricle is larger than the left, and joins the right Ventricle by a common tendinous Opening. It has two other Openings united into one, and formed by two large Veins that meet and terminate there, almost in a direct Line, called Vena Cava Superior and Inferior. The scissure Margin of this Auricle terminates obliquely in a kind of obtuse Apex, which is a small particular Production of the great Capsula, and is turned towards the Middle of the Basis of the Heart.

The whole internal Surface of the right Auricle is uneven, by reason of a great Number of prominent Lines that run across the Sides of it, and communicate with each other by smaller Lines, that lie obliquely in the Interstices between the former. The Lines of the first Kind represent Trunks, and the others small Branches, in an opposite Direction to each other: In the Interstices between these Lines, the Sides of the Auricle are very thin, and almost transparent, seeming to be formed merely by the external and internal Tunics of the Auricle joined together, especially near the Apex.

The left Auricle is, in the human Body, a kind of muscular Capsula, or Reservoir, of a pretty considerable Thickness, and unequally square, into which the four Veins open called Venæ Pulmonares, and which has a distinct Appendix belonging to it, like a third small Auricle. This Capsula is very even on both Sides, for which Reason one might be led to call it the Trunk of the pulmonary Veins, and its Appendix the left Auricle.

Auricle. However, the Capsula and Appendix have but one common Cavity; and therefore may still be both comprehended under the common Name of the left Auricle. In Men, the small Portion may likewise be named the Appendix of the left Auricle, but in other Animals the Case is different.

This small Portion or Appendix of the left Auricle is of a different Structure from that of the Capsula or large Portion. Externally it resembles a small oblong Bag, bent different Ways, and indented quite round the Margins; internally it is like the Inside of the right Auricle. The whole common Cavity of the left Auricle is smaller in an adult Subject than that of the right; and the muscular Fibres of this left Auricle cross each other obliquely, in Strata differently disposed.

Besides the great common Vessels, the Heart has Vessels, peculiar to itself, called the coronary Arteries and Veins; because they, in some measure, crown the Basis of the Heart. The coronary Arteries, which are two in Number, rise from the Beginning of the Aorta, and afterwards spread themselves round the Basis of the Heart, to the Substance of which they send numerous Ramifications.

The external Course of the Veins is pretty much the same with that of the Arteries; but they end partly in the right Auricle, and partly in the right Ventricle: They likewise terminate in the left Ventricle, but in smaller Numbers; and in both they end by certain venal Ducts, which open into the Fossulæ or Lacunæ already taken Notice of, in the uneven internal Sides of the Ventricles. There are likewise Lacunæ of the same Kind in the Auricles between the prominent Lines before-mentioned; and in the great Capsula of the left Au-

Auricle we find likewise small Foraminæ which seem to have the same Use.

There are seldom more than two Arteries; one of which lies towards the Right, the other towards the Left of the anterior third Part of the Circumference of the Aorta. The right coronary Artery runs in between the Basis and right Auricle, all the way to the flat Side of the Heart, and so goes half way round; the left Artery has a like Course between the Basis and left Auricle; and, before it turns on the Basis, it sends off a capital Branch, which runs between the two Ventricles: Another principal Branch goes off from the Union of the two Arteries on the flat Side of the Heart, which, running to the Apex, there joins the other Branch.

The coronary Veins are distributed exteriorly, much in the same Manner. Their Trunk opens principally into the right Auricle by a particular Orifice furnished with a semi-lunar Valve. All the coronary Veins and their Ramifications communicate with each other so, that if we blow thro' a small Hole made in any of these Branches, having first compressed the Auricles and large Vessels, we see, that the Air swells all the Vessels, and the Ventricles likewise by passing through the Ductus Venosi.

The Heart lies almost transversely on the Diaphragm, the greatest Part of it being in the left Cavity of the Thorax, and the Apex being turned towards the osseous Extremity of the sixth true Rib. The Basis is towards the right Cavity; and both Auricles, especially the right, rest on the Diaphragm.

The Origin or Basis of the pulmonary Artery is, in this natural Situation, the highest Part of the Heart on the anterior Side; and the Trunk of this Artery lies in a perpendicular Plane, which may be conceived to pass between the Sternum and the

Spina Dorſi : Therefore ſome Part of the Baſis of the Heart is in the right Cavity of the Thorax ; and the reſt, all the way to the Apex, is in the left Cavity : And it is for this Reaſon that the Medi-aſtinum is turned towards that Side.

According to this true natural Situation of the Heart, the Parts commonly ſaid to be on the right Side are rather anterior, and thoſe on the left Side poſterior ; and that Side of the Heart, which is thought to be the anterior Side, is naturally the ſuperior Side ; and the poſterior Side, conſequently, the inferior Side.

The inferior Side is very flat, lying wholly on the Diaphragm ; but the ſuperior Side is a little convex through its whole Length, in the Direction of the Septum, between the Ventricles. And it may be proper here to remark, that though commonly received Terms of Art may ſtill be retained, yet it is neceſſary to prevent their communicating falſe Ideas to thoſe who have not had an Opportunity of making Obſervations themſelves, or of being inſtructed by others.

There are ſtill ſome other anterior Veins of the Heart : But one, more particularly large, goes along the adjacent Margin of the right Ventricle, and, running for ſome Length obliquely between the Membranes, is inſerted into the moſt anterior Part of the right Auricle, and ſometimes into the Trunk of the ſuperior Vena Cava. This anterior Vein ſends off another concealed, or through the Root of the right Sinus ; and, being again terminated in the great coronary Vein, makes a complete Circle round the Heart like arterial ones, which ſome have deſcribed, but I have not yet ſeen it. HALLER.

As for leſſer venal Circles about the Heart, as well as the ſaid arterial one, they are not yet ſufficiently confirmed.

There

There are also a great many more Veins, of which it is uncertain whether they belong to the Basis and internal Parts of the Heart, to which Anatomists have seldom any Access, because they lie concealed between the Origins of the large Vessels; and these open and terminate, by a Multitude of Orifices, in the right Sinus and Auricle; and some, but only a few, in the left one.

Thus HALLER has seen a particular Vein, which, from a latent Sinus in the muscular Substance of the right Auricle, has ascended towards the Aorta and pulmonary Artery, and terminated, on one Side, in the greater coronary Vein. He saw another concealed between the Orifice of the same Vein and the Aorta, terminated in the right Sinus; and also another through the Remains of the Foramen Ovale and Septum; the two Sinuses terminating in the right Sinus; and others, again, belonging to the venal Valves: Besides which, there are still others, too numerous to describe.

Some other much smaller Veins in the Heart, whose little Trunks, being very short, cannot easily be traced by Dissections; and these terminate, by an infinite Number of oblique small Orifices, through all the numerous Foveæ, or little Sinuosities and Excavations, observable throughout the Surface of both the Ventricles.

These are demonstrated by injecting the coronary Arteries, after you have first tied their corresponding Veins. HALLER. Prim. Lin. Physiol.

There are some Authors who will have the coronary Arteries filled with Blood, not at the Time of the Systole of the Heart, but of that of the Aorta; which they think must be a Consequence of the retrograde Angle of the Blood's Course here, and the Paleness of the contracted Heart,

on a Supposition that the Valves of the Aorta cover or close the Orifices of the coronary Arteries.

But the two last Suppositions do not correspond with Experiments. For the retrograde Course can only impede, or lessen, and not intercept the Flux into the Heart. For injecting Air or Mercury into all the feminal and biliary Vessels, demonstrate, that the large retrograde Angles, which the Vessels often there make, do not hinder the Fluids from taking their natural Course, though they retard it.

But what is more evident is, that the coronary Artery; and Blood starting from it, make a higher Saltus at the Time when the Heart is contracting.

Concerning the Reflux of Blood from the muscular Substance of the Heart, there is still less room to doubt: For all the coronary Vessels discharge their Contents into the Auricles and Ventricles, either right or left, but less in the latter. The Circulation through these Vessels seems to be completed in the shortest Space of Time that can be in any Part, from the great Velocity the Blood receives from the Heart itself, urging the same through its own Substance. But that the whole Contents of the Vessels are cleared in each Contraction, HALLER does not think it probable: For the sanguineous Vessels of the Heart do not look pale enough, in that Action, to produce such an Effect as an entire Evacuation.

There is a very free Communication between the Arteries of the Heart into its cellular Membrane. If it be asked, What are the Uses of those least or shortest Veins which open obliquely through the Surfaces of both the Ventricles? We answer, They serve to receive the Blood of those deeply-seated small Arteries, within the muscular Substance, which have no corresponding Veins running by their Sides like those on the Surface.

The

The lymphatic Veins of the Heart, which accompany the coronary sanguineous Vessels, and ascend towards the thoracic Duct and subclavian Vein, are very rarely to be seen. HALLER. Prim. Lin. Physiolog.

OBSERVATION.

It appears, from what has been said, that the Force of the Heart is manifestly great in those who have strong Fibres, not too easily irritable, with a Pulse large, and moderately slow. For the Number of Pulses being given, the Strength of the Body, Health, and Disease, will be as its Magnitude, if the Arteries are duly pervious; and if the Magnitude be given, the Patient's Strength will be as the Slowness of the Pulsations, if there be no obstructing Cause at the Heart: So the Strength will be in a Ratio compounded of the Magnitude and Slowness of the Pulse. Thus the Person's Strength, and the arterial Resistance, with the Tenacity of the Humours, being the same; the Quantity of the Heart's Contraction will be as its Irritation, from the Plenitude and Tension of its Ventricles. The arterial Resistance and Heart's Plenitude being the same, its Contraction will be as the nervous or muscular Strength of the Body: Or the Heart's Strength and Plenitude being given, its Systole will be as the Resistance inverfly.

If the Heart, weakened, throws out less than it receives; the Pulse quickens, to compensate the want of Magnitude: And so the Heart may labour with Oppression, either from the venal Pressure increased; from the arterial Resistance augmented; or from a nervous Weakness of the muscular Strength, or vital Powers: And these make the immediate Cases of Fevers, which result, again, from Changes, made by the Nonnaturals, either in the automatic and muscular Powers of the Heart and Arteries, in the Encephalon and nervous System;

stem; or in the Quantity and Quality of the Blood and principal Humours thence secreted. Dr. MIHLES's Remark on HALLER's Physiology.

The Heart, with all the Parts belonging to it, is contained in a membranous Capsula called Pericardium, which is, in some measure, of a conical Figure, and much bigger than the Heart. It is not fixed to the Basis of the Heart, but round the large Veins above the Auricles, before they send off the Ramifications, and round the large Arteries, before their Divisions.

The PERICARDIUM is composed of three Laminae, the middle and chief of which is composed of very fine tendinous Filaments, closely interwoven and crossing each other in different Directions. The internal Lamina seems to be a Continuation of the external Tunic of the Heart, Auricles, and great Vessels; the Trunks of the Aorta and pulmonary Artery have one common Tegument which contains them both as in a Sheath, and is lined on the internal Side by a cellular Substance, chiefly in that Space which lies between where the Trunks are turned to each other, and the Sides of the Sheath. There is but a very small Portion of the inferior Vena Cava contained in the Pericardium.

It is the middle Lamina which chiefly forms the Pericardium; and the Figure of this Capsula is not simply conical, its Apex being very round, and the Basis having a particular Elongation which surrounds the great Vessels, as amply as the other Portion surrounds the Heart.

The Pericardium is closely connected to the Diaphragm, not at the Apex, but exactly at that Place which answers to the flat or inferior Side of the Heart; and it is a very difficult Matter to separate it from the Diaphragm in Dissection. This adhering Portion is, in some measure, of a triangular Shape, corresponding to that of the inferior
Side

Side of the Heart; and the rest of the Capsula lies upon the Diaphragm, without any Adhesion.

The external Lamina or common Covering, as it may more properly be called, is formed by the Duplication of the Mediastinum. It adheres to the proper Capsula of the Pericardium by the Intervention of the cellular Substance in that Duplication, but leaves it where the Pericardium adheres to the Diaphragm, on the superior Surface of which it is spread, as being a Continuation of the Pleura.

The internal Lamina is perforated by an infinite Number of very small Foramina, through which a serous Fluid continually transudes, in the same Manner as in the Peritonæum: This Fluid, being gradually collected after Death, makes what is called Aqua Pericardii, which is found, in considerable Quantities, in opening dead Bodies while they remain fresh. Sometimes it is of a reddish Colour, which may be owing to a Transudation of Blood through the fine Membrane of the Auricles.

The Heart, and Parts belonging to it, are the principal Instruments of the Circulation of the Blood. The two Ventricles ought to be considered as two Syringes so closely joined together as to make but one Body, and furnished with Suckers placed in contrary Directions to each other, so as that, by drawing one of them, a Fluid is let in, and forced out again by the other.

The Heart is composed of a Substance capable of Contraction and Dilatation. When the muscular Fibres of the Ventricles are contracted, the two Cavities are lessened in an equal and direct Manner, not by any Contorsion or Twisting, as the false Resemblance of the Fibres to a Figure of 8, has made Anatomists imagine: For if we consider attentively in how many different Directions,

and in how many Places, these Fibres cross each other, as has been already observed, we must see clearly, that the whole Structure tends to make an even, direct, and uniform Contraction, more according to the Breadth or Thickness, than according to the Length of the Heart; because the Number of Fibres situated transversely, or almost transversely, is much greater than the Number of longitudinal Fibres.

The musculous Fibres, thus contracted, do the Office of Suckers, by pressing upon the Blood contained in the Ventricles; which Blood, being thus forced towards the Basis of the Heart, presses the tricuspidal Valves against each other, opens the Semi-lunares, and rushes, with Impetuosity, thro' the Arteries and their Ramifications, as thro' so many elastic Tubes.

The Blood, thus pushed on by the Contraction of the Ventricles, and afterwards pressed by the elastic Arteries, enters the capillary Vessels, and is from thence forced to return by the Veins to the Auricles, which receive and lodge the Blood returned by the Veins during the Time of a new Contraction. This Contraction of the Heart is, by Anatomists, termed Systole.

The Contraction or Systole of the Ventricles ceases immediately, by the Relaxation of their musculous Fibres, and in that Time the Auricles which contain the venal Blood, being contracted, force the Blood through the tricuspidal Valves into the Ventricles, the Sides of which are thereby dilated, and their Cavities enlarged. This Dilatation is termed Diastole.

In this Manner does the Heart, by the alternate Systole and Diastole of its Ventricles and Auricles, expel the Blood through the Arteries to all the Parts of the Body, and receive it again by the Veins;

Veins : This is called the Circulation of the Blood, which is carried on in three different Manners.

The first and most universal Kind of Circulation is that by which almost all the Arteries of the Body are filled by the Systole of the Heart, and the greatest Part of the Veins evacuated by the Diafole.

The second Kind of Circulation opposite to the first, is through the coronary Vessels of the Heart, the Arteries of which are filled with Blood during the Diafole of the Ventricles, and the Veins emptied during the Systole.

The third Kind of Circulation is that of the left Ventricle of the Heart, through the venal Ducts of which a small Quantity of Blood passes without going through the Lungs, which is the Course of all the remaining Mass of Blood.

Besides these three different Kinds of Circulation, there are some Peculiarities in the Course of the Blood which may be looked on as particular Circulations : Such is the Passage of the Blood through the Liver, Spleen, Corpora Cavernosa of the Parts of Generation, and through the cavernous Sinuses of the Dura Mater. I do not here examine the Circulation peculiar to the Fœtus, nor in the minute Vessels.

CONJECTURAL OBSERVATION.

If it be demanded, Why the Heart never ceases from its perpetual Motion, for so many Years as there are in a Man's Life, through so many Hours as are in a Day ; when, in each Hour, the Heart of a healthy Person contracts not much less than five Thousand Times ; so often are there successive Repletions, followed with new Contractions, perpetually in the same constant Order. Nor is there any other Muscle, besides the Heart and Diaphragm, but what becomes tired and painful, by acting incessantly, even for a few Hours.

Various Answers have been given to this Question, by ingenious Men, founded either upon a Compressure of the cardiac Nerves between the large Arteries, or upon an alternate Repletion of the coronary Arteries, Cavities of the Heart, &c.

HALLER thinks, that the Simplicity of Nature seems very great in this Matter. When the Auricle is relaxed, it is immediately filled by the muscular Force of the continuous great Vein; and so the Heart also contracts itself, when, in like manner, it is irritated by the Blood driven into it from the Auricle: Therefore the Heart, having once received the Blood, is contracted by that Stimulus, or irritable Force, whereby muscular Fibres are excited to a Contraction; whereupon, it empties itself of the Blood; and, being free from the Stimulus thereof, immediately rests, and relaxes itself. But the Heart being now relaxed, the Auricle is, in like manner, irritated by its contained Blood, and, by contracting, fills it again; while the incessant Actions of the Heart and Arteries continually urge new Fluids into the right Sinus of the Auricle. The Motion ascribed to the Vena Cava is, from the right Auricle throwing back some Blood again into the superior and inferior Cava; because now the fainting Heart will not receive it all.)

That this is the true State of the Heart's Motions, is proved by actual Experiments and Observations; whereby we plainly discern the successive Repletions and Contractions made in the great Vein, Auricle, Ventricle, and Artery, easily seen in a weak or expiring Animal; but more especially, and more evidently, in those Animals that have but one Ventricle in the Heart; as the Tortoise, Frog, Snake, Fishes, and in the Chick hatching in the Egg: Which, instead of a Heart, has only one crooked Canal.

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The same is also confirmed from the Resting of the Heart, which follows upon tying the Veins, and from the Return of its Motion by removing the Ligatures, or by the Impulse of the Wind or Liquors injected; and, lastly, from the perpetual Contraction of a Frog's Heart, round or upon a Vesicle of Air inflating it; which Air, urged into it by the Vesicle, will alternately receive, and, for many Hours, transmit to the common Air.

Hence it appears why the Auricles, and especially the right, are the last of all moving, if you except the next continuous Part of the Vena Cava: Because the Heart is irritated into Motion by the Blood sent towards it, by a Contraction of the extreme Parts from the Cold invading the Body; at which Time the Lungs, destitute of the Act of Respiration, resist the Blood of the right Ventricle; but the left, receiving none, stands still for want of Irritation.

Nor does HALLER believe that there is any Thing more than this required for the Heart's Motion. For if we derive the Heart's resting, from a Compressure of the Nerves, the Motion of the Auricles will be an Objection: whose Nerves, in order to that, ought not to be compressed: And, for Example, in Fish, and the little Chicken in the Egg, there can be no Room for a Compressure of the Nerves.

If, again, you deduce the Heart's Rest from a Compressure or Occlusion of the coronary Arteries, this is contrary to Experience; since they are not covered by the Valves of the Aorta; and from a Wound of the said Arteries, during the Systole of the Heart, the Blood starts out to a great Height: And, again, its Motion still continued, after they were tied by the late Dr. CHIRAC.

But there is such an absolute Impatience in the Fibres of the Heart to bear any Stimulus, that,
even

even when the Viscera are almost dead, this appears to have a kind of Motion within its own Fibres; which, beginning in a sort of radiant Point, is propagated, in Wrinkles, to the adjacent Parts: If, now, you pull out the Heart, although it be growing cold, and then puncture, inflate, or irritate its Membranes, the Fibres of the extracted Heart become corrugated in Circles, notwithstanding there is not now a continuous Nerve or Artery to supply the beating Heart. (And this Irritability of the Heart is more exquisite and durable than in any other Part of the Body; because we see that it may be thereby recalled into its former Motion by a Stimulus, when no other Muscle can be so excited.)

But with what Celerity, and with what Force, the Heart drives the Blood, is controverted, and variously computed. The more modern Authors have founded their Calculations on a Supposition that, for the Celerity to be determined, we are to admit two Ounces of Blood to issue out of the Heart with Celerity; that the Part of the whole Pulse, called its Systole, makes one Third of the whole Pulsation, and is finished within a $\frac{1}{2\frac{1}{2}5}$ -th Part of a Minute; but the Area of the Orifice of the Aorta they have estimated 0.4187 Parts of an Inch; so, by dividing the Space filled by two Ounces of Blood, (3.318 Inch) by the Area of the Section of the Aorta at its Orifice, (and the Length of its Cylinder filled by two Ounces, viz. $= 7\frac{29309}{33180}$) the Number thence produced divided by $\frac{1}{2\frac{1}{2}5}$, the Time in which the Heart contracts, they find 149 Feet, and two Tenths of an Inch, for the Space through which the Blood runs in a Minute, if it goes on, in a Cylinder, with the same Velocity it first had from the Heart, which it does not. But the incumbent Weight of the Blood moved by the Heart, they have computed by the
 Jet,

Jet, wherein the Blood starts forth from the larger Arteries in a living Animal, being seven Feet five Tenths, and from the Surface of the Ventricle, the whole Area makes fifteen Inches; which produce 1350 cubical Inches of Blood, or 51 Pounds 5 Ounces, which press against the Ventricle of the contracting Heart. The Heart, therefore, thus drives forward a Weight of 51 Pounds with a Velocity by which it may run through 149 Feet in a Minute; which Force it exerts 4800 Times in an Hour.

Although there are many Particulars here, unthought of, which may render the Estimate incomplete, and such, perhaps, as we may never get over; and although the Area of the Ventricle be of so uncertain Dimensions, and the Jet of Blood computed from an insufficient Height; yet, if we consider the Violence with which the Blood starts from some of the least sanguine Arteries in the living Animal, although we cannot easily determine how much of the Heart's Systole it assumes to itself, and a Variation, in this, will greatly alter the Computation: Yet, in the mean Time, it will plainly appear, that the Muscles we call the Heart, make a very powerful Machine.

The Truth of this is evident from various Experiments; in which it appears to be very difficult to fill all the sanguineous Vessels by anatomical Injections, and quite impossible to fill all the smaller of them: Yet the Heart, by the Help of the Elasticity of the Arteries, we see, not only gradually distends all the larger, the smaller, and even the least Arteries: I have seen, the Blood starts forth several Feet, the Jet describing a Parabola, whose Height was four Feet, and Amplitude of the Projection seven: And assert, that they have seen the Blood ascend from the Aorta to the Height of 12 Feet.

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There is no doubt but the Heart moves not only the whole Mass of the animal Fluids, but also all the yielding Solids, and even every individual yielding Fibre is elongated by each Systole: But then this is owing to the Mechanism also of the arterial Fabric, which makes a Leaver of very great Purchase, for multiplying and transferring the Force of the Heart, which the Arteries receive and apply, so as to produce great and extensive Effects.

But then we must not ascribe to the Heart, alone, Effects which it can produce only by the Assistance of the Arteries; and, if all Circumstances be duly considered, the Heart's Force will be found so far short of BORELLI's enormous Calculation, that it will be less than any Computation yet observed of it.

As to the Time in which the Mass of Blood may make a complete Circulation thro' the Heart, as it flows with an irregularly decreasing and increasing Motion, that varies in every Artery, and in Veins, proportionably to their several Lengths, Diameters, Angles, Inflexions, Strength, &c. no one can justly determine it.

The Return of the Fluids may be twenty Times quicker through the coronary Vessels of the Heart, with those of the intercostal and diaphragm Muscles, than in many other Parts: And it may move an hundred Times slower through the least Vessels of the Liver, than in the largest Veins at the Heart.

However, on Dr. HALE's Principle, the larger Arteries may shift their Contents into the Veins, and the smaller ones may pass their Blood through the Heart, once in about five or six Minutes; in which Time the Majority of the Current passes the Heart in one complete Round. MIHLES's Observations.

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Moreover, that we may make a just Estimate of the Heart's Force in living Animals, we must consider what great Resistances that complex Muscle overcomes; we must compute the enormous Weight there is of the whole Mass of Fluids, perhaps about fifty Pounds: For all that Quantity, one stagnant in a Person lately drowned, or fainted away, are easily put into their former Motion by the Heart only.

We must again observe the great Decrease of the Blood's Velocity, arising from the greater Capacity of the dividing Branches (from whence the Ratio of its Celerity, even in the Intestines, may be computed to only a 24th or a 30th Part of its original Impulse), abates two Thirds from the Heart's Force: And yet we see there are Humours swiftly moved through much smaller Vessels. For Example, in those of the Sanctorian Perspiration; which, in a subterraneous Cavern, HALLER has observed to ascend swiftly in Form of Vapour or Smoke: And the same Celerity of the Blood, in the capillary Vessels of small Fishes, &c. is visible to the Eye by Help of a Microscope.

Now since the Frictions, in every Machine, always consume a great Part of the moving Forces; much more do they in the human Body, whose Blood and Juices are so much more viscid or clammy than Water, and pass through Vessels so minute, that they permit only a Globule to pass at a Time, and even hardly allow that, without changing its Figure. But from so strange and extended a Friction must necessarily follow, a very great Hindrance to the Motion: Whence we may easily understand, that the Force must be very great, which drives so swiftly such a prodigious Mass of Fluids over so many Resistances and Decrements of the moving Forces. HALLER.

It is proper we should observe here, that the Heart fills the smaller Vessels, not at once, but by repeated Systoles, with the Aid of the Elasticity of the Arteries which communicate in a serpentine Manner: We are also to consider, that a very small Part only of these Resistances is removed, each Time, by any single Systole, to which the Arteries serve as a multiplying Spring by their elastic Force, proportionable to their Distension, and drive progressively the Mass of Fluids, in the same Manner as the Air, by its Elasticity, throws out a continued Stream with a Celerity proportionable to its Compressure, in the Fire Engine, &c. For as the arterial Valves of the Heart, which sustain a Part of this elastic Force equal to their Surface, will admit of various Apertures; the Heart acts on that hydraulic Law, whereby any Force or Pressure, ever so weak, by urging a Fluid through an Aperture, proportionably small, shall overcome any Resistance, or raise any Weight, ever so great. So that, whenever the arterial Resistance is increased, or the muscular Force of the Heart abated, its Valves are opened by a proportionably smaller Column of Blood; which, in a natural easy Systole, is seldom more than Half the Contents of either Ventricle; as, in a natural Expiration, the Lungs seldom expel more than Half their contained Air.

Hence it appears, that to allow an Opening to the Valves, equal to the Orifice of an Artery, and the Quantity of Blood expelled, to be equal to the Capacity of the Ventricle, are Concessions too great, by Half, to estimate the natural Force of the Heart; which, when reduced to but a few Ounces, is yet, according to the hydraulic Principle, able enough to maintain the Circulation.

AN ESSAY ON THE CAUSE OF THE MOTION
OF THE HEART. By HALLER.

Although this Essay is but short, yet it will have its Uses; seeing you will find an Experiment in it, which I have made several Times, and which proves that the Motion of the Heart, by perpetual alternate Contractions and Relaxations, depends upon Irritations occasioned by the venal Blood which is sent thither.

All the Explanations which have hitherto been given of this Phænomenon, are destroyed by the human or comparative Anatomy.

We know perfectly well, that the right Ventricle, and especially its Auricle, are the last Parts of the Body which preserve any Motion. GALEN, HARVEY, and BOERHAAVE, were convinced of this by Experiments.

I have long suspected, that the Continuance of this Motion depended upon the Blood which the Venæ Cavæ, contracted by the Cold, and compressed by the Palpitations and Weight of the Muscles, send continually to this Ventricle; whereas the Lungs of a dying Animal, being motionless and collapsed, no longer admit the Blood by the pulmonary Artery; and that all the Quantity, which its Contraction can force into the left Auricle, is too inconsiderable, compared with that which returns from the whole Body to the right Auricle, to produce a sensible Effect. It may therefore be affirmed, that if the right Ventricle and Auricle move longer than the left Auricle, it is because the venal Blood is sent longer thither.

I determined to confirm my Conjecture by Experiments; and, in order to this, it was necessary, if possible, to prevent the Entry of the Blood into the right Ventricle; and if, by this means, its Mo-

tions were stopped, that was a Proof that they actually depended upon the Access of the Blood.

I attempted this Experiment, at first, by Ligatures; because I remember to have read in BARTHOLIN and BERGER, that the tying up of the Veins makes the Motion of the Heart cease; and that it begins again when the Ligature is cut. And HARVEY says, that he has made the same Experiment upon a Serpent.

But the Experiment, done in this Manner, did not succeed; because, as long as the Animal is still warm, the Blood contained in the right Auricle continues to move it, though there is none sent to it by the *Venæ Cavæ*: And after having tried them on three young Cats, the Motion of the Blood continued as before. The same Thing happened to BLANQUET, in the Experiments related by Dr. SENAC.

This made me resolve to slit both the Causes: I should have cut them quite off, if I had not been afraid, that then the Cessation of the Motions of the Heart would have been attributed to the want of its necessary Supporters. After having slit them, I emptied them of all their Blood, and tied them; I next emptied the Auricle, and then the Success of the Experiment was always constant. As soon as I had freed the Auricle of all its Blood, and prevented it from receiving any afresh, immediately its Motion entirely ceased. As it is more difficult to empty the Ventricle than the Auricle, and as it yields to the Impressions which are communicated to it by the left Ventricle; I sometimes observed there a gentle Motion, but incomparably weaker than that which it has when it receives the Blood from its Auricle and the *Venæ Cavæ*.

But there still remained a more authentic Experiment for me to make. In the natural State
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the right Ventricle moves longer than the left; because, as I said before, it receives the venal Blood longer than the other. To prove, to a Demonstration, that the Blood is actually the Cause of the Heart's Motion, there is nothing farther required to be shewn than that if the right Ventricle and its Auricle are deprived of the Blood, while the left Ventricle is not, the first immediately loses its Motion, while the other still continues to act.

In order to succeed in this Experiment, the Ventricle must first be perfectly emptied, by opening the pulmonary Artery and Venæ Cavæ, and the emptying the left Ventricle prevented, by tying the Aorta; and, after this is done, we must examine narrowly, if the Motions of the right Ventricle cease, and if the left and its Auricle continue theirs.

After some Attempts, which the Difficulty of so delicate an Undertaking, and the sudden Death of the Animals, rendered fruitless; the Experiment, at last, succeeded to my Wish; viz. the right Auricle remained perfectly quiet, and its Ventricle preserved no other Motion than that which was a necessary Consequence of the Connexion of its Fibres with those of the left Ventricle, and which pulled the external Parietes towards that which separates the two Ventricles from each other. The left Auricle preserved its Motion for some Time, the left Ventricle still longer; and I have sometimes observed this last contract two Hours after the other had ceased.

When the Experiment succeeded exactly, the Blood mounted from the Apex to the Basis of the left Ventricle, and descended again from the Basis to the Point, and then the left Ventricle, as long as it preserved any Motion, appeared likewise to descend. At other Times, as I have seen in a

Kid, it had no Motion at all. This Experiment succeeded best when the left Auricle emptied itself freely into the Ventricle, and the Passage of the Blood from the Ventricle into the Aorta, which was tied, was entirely stopped. The Apex of the left Ventricle was always the Part which preserved its Motion the longest. By this means, the Property of being the last living Part of the Body is transferred from the right Ventricle to the left, by preserving longer, in the last, the Irritation produced by the Contact of the Blood.

A new Force may be given to this Experiment, by trying to blow into the right Ventricle; by which Irritation its Pulsations are renewed.

Farther: I have always remarked, that the internal Surface of the Heart is much more irritable than the external: For, when I irritated this last with the strongest Poisons, the Motion thereby communicated to the Heart soon ceased; whereas the Irritation communicated to the internal Surface, by means of Air alone, especially in Frogs, and even in Cats, Motions which subsisted a very long Time, even after all the Parts were quite cold.

I have repeated this last Experiment nine Times; viz. of preserving the Motion of the left Ventricle after all the other Parts were deprived of theirs; seven Times upon Cats, and twice on Kids. The violent Struggling and Agitation of Dogs, render them improper Subjects for this Purpose.

MORBID CASES OF THE HEART, &c.

VIEUSSENS found, in the Body of a Soldier, aged Thirty-five Years, who died of a Defluxion of the Breast, two Hearts; one of which, that he thought was perfect in its Conformation, and in its natural Situation, but had no Pericardium:
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The other Heart, whose Figure was pyramidal, and as large as a Hen's Egg, had a Pericardium, which adhered on its external Surface. A large Branch of each subclavian Vein was inserted into its Basis and Cavity, which terminated on its right Side at the superior Trunk of the Vena Cava. This Heart had no Auricles, but only a Cavity, which we have just mentioned, which may be looked upon as a Ventricle: This was situated above the other, and reached the Basis by its Apex. Vid. VIEUSSENS. Tract. Cord.

Often in the Ventricles of the Heart, and Prominence of the pulmonary Artery and Aorta, is found Concretions of Fluids, especially in Persons of advanced Age; but sometimes I have found, even in Children, those Concretions named Polypuses. RIOLANUS says he has found them as big as the Wrist.

CHESELDEN found, in the Pericardium of a Boy, a great Quantity of Pus, and the Basis of the Heart ulcerated. He observes, that, in Persons who died of a Dropsy, the Heart is generally large, its Fibres lax, and the Vessels about it immoderately distended; with Polypuses, sometimes, in both Auricles, Ventricles, and Veins.

Mr. PILE has prepared a Heart, thus diseased, whose Circumference, from the Apex round the Basis of the Auricles, measures Twenty-four Inches and a Quarter; and round the Basis of the Ventricles, Seventeen Inches and a Half.

CHESELDEN dissected a Man, who died tabid, in whom the Pericardium universally adhered to the Heart; and a Portion of it, as large as a Six-pence, was ossified.

The Beginning of the Aorta is frequently indurated, especially in aged Persons.

CHESELDEN found, in a Woman who died of a Dropsy, the Valves of the Aorta quite covered

with petreous Matter; which not suffering them to perform their Functions, the left Ventricle of the Heart was constantly overcharged with Blood, and distended to above twice its usual Bulk.

In a Man who died with excessive Palpitations of the Heart, and an irregular Pulse, which began after hard Drinking in extreme hot Weather some Years before, the same Person found about Ten Inches of the Aorta, nearest to the Heart, distended three Times more than its usual Diameter: And in another Man, of One Hundred and Three Years old, he also found the same Part of the Aorta expanded to twice its natural Capacity, without any Symptom of the Disease in his Lifetime. See his Anatomy.

BLANCHARD relates, that he found a Heart of a whitish Colour about the Middle. Towards the Diaphragm it was ulcerated, putrid, and partly consumed, without any Fluids in the Pericardium: The Lungs were also of a whitish Colour, and adhered to the Ribs and Diaphragm. Vid. Observatio XL.

He also found, in a Girl of Ten Years old, who was troubled with a Pulsation in the Heart, which was ulcerated, and very near half consumed. Ibid. Observ. LXXXIII.

OBSERVATIONS.

BONETUS speaks of a Man, who died of a Dropsy, in whose Pericardium there was found Thirty Ounces of Water. Obs. LX.

PISO says of JACOB LORET, who had long laboured under a Palpitation of the Heart, and Difficulty of Breathing, that, upon Dissection, several Pints of Water were found in the Pericardium. Vid. De Serof. Colluv. Obs. xxxix.

Dr. STORKIUS informs us, that he ordered the Sternum to be perforated after a Wound received

in the Thorax, whereby Six Pounds of Blood, diluted with Water, was evacuated. Also the left Side of the same Man was opened, from which more than Nine Pounds of a sanguineous gelatinous Matter issued. The Patient lived a Month after the Perforation of the Sternum, and Three Days after the opening of the Thorax.

GALEN is pleased to tell us, that he ordered the Sternum of a Boy, whose Portion was carious, to be cut off; seeing Part of the Pericardium corrupted, took it away also, and left the Heart quite naked; and yet the Boy soon recovered. Vid. De Anatom. Administrat. Lib. VII.

Professor SPROEGLIUS says, he found the Pleura of a hanged Man callous, and some of the Glands (as he calls them) scirrhus; and the posterior Part of the Pleura, which lined the Thorax, was like a Piece of Leather.

He also relates another Case of a Youth, in whom he found the inferior Part of the right Ventricle of the Heart half petresied.

He likewise mentions the Case of another Youth, in whom he found the external Surface of the Pericardium full of a white Scirrhus, and some Places hard. As it was full of Pus, the Scirrhus closely adhered to the Heart; the inferior Part of the right Ventricle of the Heart was half petresied with small Stones, which adhered to the Pericardium; the two membranous Sinuses of the Valves of the Aorta were callous, and partly petresied, &c. Vid. HALLER. Opusc. Pathol. Obs. XLVIII & LII.



LECTURE XXII.

Of the SYSTOLE and DIASTOLE of the
HEART*.

THE Heart is a Viscus which has given the Learned a great deal of Trouble to find out its real Mechanism, and the true Cause of its regular Alterations of Contraction and Dilatation.

I have oftentimes laid open the Thorax of a Dog, and kept his Lungs playing, with a Pair of Bellows, in order to observe how regularly and alternately the Systole and Diaſtole, both of the Heart and its Auricles, followed each other; that is, when the Ventricles were contracted, the Auricles were dilated, and vice versa: So that the Auricles seem, in some measure, to act as Antagonists to the Ventricles; and the reflux Blood may be of the same Service to the Auricles.

But there being so great a Disparity between the contractile Strength of the Ventricles and that of the Auricles, there must necessarily be some other Cause; which, when the Heart is fully contracted, makes it unbend again, or cease to con-

* This LECTURE is taken from the ingenious Dr. BROWN LANGRISH's Third LECTURE, read before the ROYAL SOCIETY 1747.

I do not know any Thing, that has been written on this Subject, more probable than this DISSERTATION.

Lect. XXII. Of the Systole, &c. 457

tract; by which means the Auricles, tho' so very weak in Comparison of the Ventricles, have Power enough to throw in Blood, and thereby to distend the Ventricles to a certain Degree, before they are capable of acting again.

If we might be allowed to make an Estimate of the Difference between the contractile Strength of the Heart and its Auricles, from the Difference of their Bulk, or Number of Fibres, we should find it to be about Nine to One; as I have observed, by weighing the Hearts of several Animals, and their Auricles, separately.

Hence it does not seem reasonable to think, that the weak Efforts of the Auricles would be sufficient to cause the Diastole of the Heart, without some other Assistant.

One great Use of the Auricles is, to receive a Quantity of Blood, during the Systole of the Heart, sufficient to fill the Ventricles again at their Diastole. The same may be said, in some measure, of the Veins nearest the Heart, which may be plainly seen to dilate during the Contraction of the Auricles; so that the Heart, Auricles, and Veins, have all their Systoles and Diastoles in subordinate Degrees.

Without such Receptacles as these, it would be impossible for the Ventricles of the Heart to be filled from the Veins so suddenly as they are. For though the Areas of the transverse Sections of the Veins are much larger than those of the Arteries; yet we find, by Dr. HALE'S Hæmastatical Experiments, that the Velocity of the Blood, in the Arteries, is above six to one to that in the Veins: But since the Auricles keep receiving the Blood, whilst the Heart is in its Systole (the Veins doing the same by the Auricles), a due Quantity of Blood is always ready to be thrown into the Heart, by
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the Time it is fit to receive it: For the Diaſtole takes up two Thirds of the Space of Time between each Pulse.

Here, then, we may obſerve, that the Momentum of the reſluent Blood acts upon, and diſtends, the Veins neareſt the Heart, whiſt the Auricles are contracted; that it alſo dilates the Auricles whiſt the Heart is in Action, and that the Heart is in its Diaſtole whiſt the Auricles are in their Syſtole.

But the great Difficulty, in accounting for the Diaſtole of the Heart, is, from the Diſproportion between its contractile Power and that of the Auricles; it being plain, from what has been ſaid above, that the Momentum of the Blood in the Veins is ſtopped by the Contraction of the Auricles; ſo that the Ventricles of the Heart can receive no other Impulſe from the Blood, at that Time, than what is derived from the Contraction of the Auricles.

Hence, therefore, it follows, that if the Syſtole was the natural State of the Heart, and to which it always tended with its full contractive Power; the Impulſe of the Blood, from the Contraction of the Auricles, could never be able to dilate it.

Dr. LOWER makes the Syſtole the natural State or Action of the Heart, and the Diaſtole the violent one; BOERHAAVE, on the contrary, makes the Syſtole the violent one, and the Diaſtole the natural State: But perhaps neither of theſe Opinions may be right, in the ſtricteſt Senſe. For, if we look back, we ſhall find, that, if the Fibres were not tenſe, they could not be elastic; and if ſome Violence was not put upon them, by the Impulſe of the circulating Fluids, they would not be tenſe. Hence it appears, that Elasticity proceeds from a State of Violence.

And

And again; when a Muſcle is freed from the Power of its Antagoniſt, and thereby left at full Liberty to contract, as it always will by its elastic reſtitutive Power only; it does ſo no farther than in Obedience to the common Power of Attraction between its component Particles: But in all other muſcular Action, when this attractive Power is greatly increaſed by the Influx of the nervous Æther, the Contraction is carried much farther, and the Muſcle more fully contracted than it ever is in the other State. Hence it follows, that Contraction, in its full eſt Degree, is not the natural State of a Muſcle.

And farther; when the conſtituent Particles of the Fibres are drawn into their cloſeſt Contacts, by the Influx of the nervous Æther, it requires ſome Force, in a contrary Direction, to elongate the Fibres again: So that Extension, or Dilatation, is alſo a State of Violence.

From the Whole, then, it appears, that neither the Syſtole nor Diaſtole, in a full Degree, is the natural State of the Heart; and this we ſhall ſhew more plainly hereafter, by inſpecting the Hearts of Animals which have been bled to Death. But to proceed:

From what has been ſaid above, it ſeems reaſonable to conclude, that if Contraction, in its full eſt Degree, was the natural State of Reſt or Qui-eſcence in the Heart, the Momentum of the Blood, from the Contraction of the Auricles, could not be a ſufficient Counterpoiſe. And ſince ſo many fruitleſs Attempts have been made to account for the Diaſtole of the Heart, from the Impetus of the Blood in the Veins, and from the Preſſure of the Atmosphere, &c. give me Leave to propoſe the following Queries:

1. May not the Heart be a compounded Muſcle; that is, may it not have its Antagoniſt within itſelf?

itself? Or, in other Words, Are not some of its Fibres so ranged, that, whilst one Set of them is contracted and shortened, others may be stretched out; analogous to the Action of the intercostal Muscles, or any other Muscles, with their Antagonists?

2. Is the nervous Æther transmitted from the Brain to the Heart, in a pulsatory Manner, at equal Distances of Time; or may it be supposed to move uniformly through the Nerves, and some Interruption is given to its Influx into the muscular Fibres, when the Heart is in its Systole?

3. Does not the Diastole of the Heart depend upon an Abatement of the Tension in the contracted Fibres; a Motion of Restitution in such as are over-stretched, and the Influx of the Blood, conjunctly?

Without some such Mechanism as this, no Power that we know of, belonging to the animal Oeconomy, would be able to cause the Diastole of the Heart: But if such a Structure, as is above mentioned, could be proved; no more Difficulty would attend the Explication of it, than that of the voluntary Muscles.

In dissecting the Heart, we find a great many different Orders or Series of Fibres, variously contorted, and running in contrary Directions: So that, for ought we know, it may be an Epitome of muscular Construction in general.

We may here observe what Care Nature has taken to prevent too great a Dilatation in the Diastole of the Ventricles, the right one especially, as being the weakest, by forming the Papillæ, or Columnæ, which run from the Septum, or middle Partition, to its opposite Sides; whereby they act as so many Braces in the Diastole; and when they contract, they also assist in the Systole. And perhaps it may not be the most improbable Conjecture

to think, that as much Care may have been taken in providing a ſufficient Number of Fibres, or little Muſcles, which may be ſo formed as to act, in the Diaſtole, as Antagoniſts to thoſe which occaſion the Syſtole.

The Hearts of Frogs, Vipers, Eels, &c. ſeem to evince the Reaſonableneſs of this Conjecture, by continuing their Syſtoles and Diaſtoles after they are taken out of the Body, when there is no reſluent Blood to dilate the Ventracles; and, conſequently, if there were no Fibres upon the Stretch, when the Heart is contracted, which, by their Elastiſcity, or reſtitutive Power, did pull back or elongate ſuch as were contracted; there could not poſſibly be any Diaſtole in ſuch Circumſtances.

We are aſſured by Mr. BOYLE, in his Phyſico-Mechanical Experiments, that the Heart of an Eel hath continued to beat an Hour, in an exhausted Receiver; after which, finding its Motion very languid, and almoſt ceaſed; by breathing a little upon that Part of the Glaſs where the Heart was, it quickly regained Motion; and, an Hour after that, finding it almoſt gone, he was able to renew it, by the Application of a little more Warmth.

The ſame illuſtrious Author farther aſſures us, that he has ſometimes cut the Heart of a Flounder tranſverſly into two Parts; and freeing each from the Blood it contained, he obſerved, for a conſiderable Time, that both of them together continued their former Contraction and Relaxation. And once, thus cutting one into ſeveral Pieces, he found, to his Surprize, that they not only moved as before, but that even the Whole, thus ſeparated, long preſerved the ſame Succeſſion of Motion, as appeared therein whiſt coherent.

Now can the Diaſtole of the Heart, in theſe Experiments, be accounted for upon any other

Principles than those we have laid down? Here was no Impulse, from the reflux Blood, to dilate the Auricles, or distend the Ventracles: The Pressure of the Atmosphere was also quite taken away in the first Experiment, and could not possibly be of any Service in the last; and yet the Diastole continued.

Can the same Fibres, which are contracted, have it in their own Power to fly out again to their usual Lengths? If this cannot be, what Power is there in a Heart, taken out of the Body, to unbend itself, or dilate its Ventracles, after they are once contracted, unless we suppose some of its Fibres to act as Antagonists to others?

We have good Reason therefore to believe, that some Fibres of the Heart are always stretched out beyond their natural Tone, when others are contracted; so that, by their elastic restitutive Property, they do act as Antagonists, in a certain Degree.

In regard to the Systole, in such Hearts as are taken out of the Body, and cut into several Pieces, we conceive, that as long as Warmth and Moisture remain, so long may the æthereal Matter in the Nerves continue to fly into the Fibres, and contract them; and, when it ceases, more Warmth, or a gentle Impulse (even with the Point of a Needle only), will revive the Motion.

Hence we may, in some measure, discover the amazing Subtilty of the nervous Æther; when such very small Sections of the Nerves, as in the abovementioned Experiment upon the Heart of a Flounder, should contain Matter sufficient for so many Contractions.

Let us now return to our second Query, and examine whether the nervous Æther is transmitted from the Brain to the Heart, in a pulsatory Manner, at equal Distances of Time; or whether some

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Interruption is only given to its Influx into the muscular Fibres, when the Heart is in its Syſtole?

In order to underſtand this, we muſt look back and conſider, that, according to our Theory, if the æthereal Medium in the Nerves was perpetually flying into the muscular Fibres of the Heart, it would be conſtantly contracted, notwithstanding the Momentum of the Blood, the Contraction of the Auricles, or the Vis Reſtitutionis in the ſtretched-out Fibres. Hence then it is evident, that the alternate Contractions and Dilatations of the Heart proceed from an alternate Influence of the nervous Æther; but how this Alternation happens, when the Nerves which ſupply the Heart are not, in the leaſt, under the Direction of the Will, is the Difficulty we labour under.

In all the Nerves which ſupply the voluntary Muſcles, it is certain there are Reſtrictions in ſome Parts of them which the æthereal Matter is not able to dilate without an additional Impulſe from the Will; or otherwiſe Cramps and Conviuſions would perpetually happen. But in thoſe which ſupply the Heart, the Motion of the Æther thro' them cannot have any Aſſiſtance or Impulſe from the Will, as not being in the leaſt under its Influence; ſo that the Vibrations of the Meninges of the Brain, and the Dilatations of the Arteries, may be ſuppoſed to be the Agents which propel the Æther towards the Heart.

Hence then it ſeems to follow, that the alternate Contractions of the Heart may proceed from the alternate Impreſſions made on the Nerves by the Meninges of the Brain, and Dilatations of the Arteries.

Upon opening the Skulls of living Animals, the Dura Mater may plainly be ſeen to have its Syſtoles and Diaſtoles correſponding to thoſe of the Arteries: But ſince the Heart continues to beat
after

after the Head is cut off, or even after it is taken out of the Body, where there cannot be any alternate Succussions made on the Nerves by the Meninges of the Brain, or the Pulsation of the Arteries; it seems reasonable to believe, that this Alternation is occasioned by some Impediment being given to any farther Influx of the Æther into the muscular Fibres of the Heart, when it is fully contracted; or, otherwise, the Heart would constantly remain in a State of Contraction, as long as there was any æthereal Matter flying from the Nerves.

If we consider in how many different Directions the muscular Fibres of the Heart run, how much they are corrugated, thickened, and swelled, when fully contracted; and how strong and uniform the Pressure must be in their greatest Degree of Action; it may not perhaps appear unreasonable to think, that the Extremities of the Nerves, which are inserted into every Fibre, and which are extremely small and tender, may be pressed upon and squeezed, so as to prevent the Influx of the Æther, till the Pressure is abated, or till the Fibres are extended again to their usual Lengths.

What seems to evince the Reasonableness of this Supposition is, the Nature of the Shaking Palsy: where the voluntary Muscles immediately become involuntary ones; so far, at least, as to be alternately contracted and relaxed without the Consent or Direction of the Mind.

Now this Distemper we believe to proceed from a particular Weakness in the Nerves, whereby those little Restrictions in them, which keep the æthereal Matter within due Bounds, in a State of Health, are so far weakened and destroyed, that the Æther has a Power of flying into the muscular Fibres without any Impulse or Direction from the Will, after the same Manner it does into the Heart.

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If, therefore, no Interruption was to be given to the Influx of the nervous *Æther* by the Muscles themselves, when they were contracted, it would follow, that if the Flexors of any Extremity were to be first contracted, the Extensors would not be able to recover the *Æquilibrium*, and to be contracted, in their Turn, without the Assistance of the Will. For if our Doctrine be right; viz. that muscular Motion proceeds from the constituent Particles of the Fibres being drawn into closer Contacts by the attractive Influence of the nervous *Æther*; it necessarily follows, that if the same Quantity of *Æther* was continually to fly into a Muscle already contracted, it would have a greater Influence on the component Particles, so approximated, than on others, in the antagonist Muscles, which are contracted; and, consequently, touch each other in fewer Points.

Hence it seems to be evident, that some Impediment is given to the Influx of the nervous *Æther* when the Muscles are contracted; or, otherwise, they would always remain so: For tho' the Will may be able to remove such little Impediments, and keep the voluntary Muscles in a State of Contraction, for a considerable Time; yet, since the voluntary Muscles, when affected with a Palsy, are regularly and alternately contracted, and have their Systoles and Diaſtoles analogous to the Heart and its Auricles; I think we have good Reason to conclude, that the same Principles which contract and dilate the voluntary Muscles, in the abovementioned Condition, are the Principles which occasion the Systole and Diaſtole of the Heart; with this Difference, only, that the Influx of the Blood into the Sinuses of the Heart, is what no other Muscle in the Body has, or receives: And, without doubt, this may truly be reckoned the greatest Assistant in dilating the Ventricles of

the Heart, after the attractive Influence of the nervous *Æther* ceases, and the *Æquilibrium* is restored between the stretched-out Fibres and those which were contracted.

What has been said seems greatly to evince the Truth of our third and last Supposition; viz. that the Diastole of the Heart may depend on an Abatement of Tension in the contracted Fibres, a *Vis Restitutionis* in such as are over-stretched, and the Influx of the Blood, conjunctly.

Give me Leave to relate two or three Experiments, which I have made, in order to illustrate the foregoing Theory, and then I shall conclude.

EXPERIMENT I.

Having observed, that the Ventricles of the Hearts of all Animals, when bled to Death, are dilated, or stand wide open to a certain Size, tho' there happens to be very little Blood in them; it seems as if the Diastole, in a certain Degree, was the last Motion of the Heart.

In order to know the Truth of this, I opened the Thorax of a Dog, and kept his Lungs playing with a Pair of Bellows, that I might perfectly see the several Actions of the Heart and its Auricles.

The Auricles seemed to me to begin the Motion, and the Systole of the Heart always instantly followed that of the Auricles; then the Apex and Sides of the Heart sunk down, and were lengthened, of their own Accord, before any Blood was thrown into the Ventricles, from the Contraction of the Auricles; for there was oftentimes more than double that Time taken up in the Diastole of the Heart, than in the Systole, which the Auricles and Ventricles required.

If I desisted from blowing fresh Air into the Lungs for some little Time, the Heart would lie still;

ſtill; and yet I could recover its Motion again, by ſtrongly diſtending the Lungs. In this Action I never could diſcern that the Heart began the Motion, but the Auricles always contracted firſt, and then the Heart immediately afterwards; though, at laſt, I ſaw ſeveral Contractions of the Auricles, which were not ſucceeded by any Motion of the Heart.

I muſt not forget to mention, that, in another Dog, I ſaw ſeveral Syſtoles and Diaſtoles of the Heart, after I had purpoſely cut aſunder both the Venæ Cavæ; and could plainly perceive the Ventricles to relax and open themſelves, when very little or no Blood could poſſibly flow into them. This, however, is much more eaſily ſeen in the Heart of a Viper, when taken out of the Body, which will continue its Syſtole and Diaſtole for a long Time; and if it ceases to beat ever ſo often, and you renew its Motion again and again, by breathing upon it, &c. you may obſerve, that the Auricle always contracts before the Ventricle; and that the Diaſtole is the laſt Motion, though there is no Blood to diſtend the Heart.

The Capacity of the right Ventricle of the Dog's Heart, in the above Experiment, as it opened of its own Accord, was ſomewhat more than a cubic Inch; as I found, by pouring in melted Wax from a Ladle, without any Preſſure from a perpendicular Height, after the Auricle and Blood Veſſels were cut off tranſverſly.

EXPERIMENT II.

Taking the Heart out of an Ox as ſoon as I poſſibly could, after he was killed, and having cleaned it from the Blood, by waſhing it in warm Water; I filled both the Ventricles with melted Wax, without any diſtending Force more than by pouring it from the Ladle: The Heat of the

Wax seemed rather to contract the Fibres, and lessen the Capacities of the Ventracles; for some of the Wax kept running out from the Heart after I had done pouring it from the Ladle.

The Capacity of the right Ventricle was equal to 5 cubic Inches and a Half; the Capacity of the left was not quite 5 cubic Inches.

From these Experiments it manifestly appears, that the last or restitutive Motion of the Heart is, to dilate or open the Ventracles, and that without any Assistance or Impulse from the reflux Blood.

Dr. HALES * injected the left Ventricle of the Heart of an Ox from a Column of melted Wax 4 Feet and a Half high, which distended the Capacity of it to 12 cubic Inches and a Half. Now supposing the Impulse of the reflux Blood to be equal to a Column of melted Wax 4 Feet and a Half high, and that in every Diastole, whilst the Ox was alive, the left Ventricle was distended to the Capacity of 12 cubic Inches and a Half; yet we may observe, that the Heart, immediately after each Systole, relaxes and dilates its Ventracles to a certain Degree, by its own Mechanism; and to whatever Capacity the Ventracles are afterwards dilated, it must necessarily proceed from the Impulse of the Blood only; all which is perfectly agreeable to our third Query; viz. that the Diastole of the Heart may depend upon an Abatement of the Tension in the contracted Fibres, a Motion of Restitution in such as are over-stretched, and the Influx of the Blood conjunctly.

EXPERIMENT III.

I took the Heart out of a live Viper, and placing it upon a Piece of writing Paper, I found it

* Hæmastatics, p. 25.

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beat at the Rate of 24 or 25 Pulsations in a Minute, for three or four Minutes: After this, I laid the Paper upon the Palm of my Hand, the Warmth of which increased the Number of Pulses to 37 the first Minute, and 48 the second. Last of all, I put it into warm Water, a Degree or two warmer than the Blood, where it beat 87 Pulses the first Minute, and afterwards declined in its Motion, more and more, till it quite ceased.

May we not from hence observe, what vast Influence Heat had upon the nervous Æther to make it fly so quick into the Heart as to increase the Pulse to almost four Times their usual Number? How far the Heat, in some sort of Fevers, may quicken the Pulse, is not to our present Purpose to enquire.

It is amazing to think, that such very small Portions of the Nerves, as were cut out with the Heart in this Experiment, should contain Matter sufficient for so many Contractions; and that it did not all of it instantly fly out from the wounded Ends, even before it was put into warm Water.

OBSERVATIONS.

The Pulse is, therefore, the Measure of the Powers which the Heart spends on the Blood; because it is the immediate and full Effect of those Powers. Hence, all Things considered as alike, the Pulse is slow in the most healthy People, where there is no Stimulus, nor any unnatural Resistance to cause the Effect of a Stimulus; but the Heart is at Liberty to send forwards the Blood with Ease.

A large Pulse is caused by Fulness of the Artery, joined with a strong Force of the Heart: But a hard Pulse denotes some Obstacle or Stimulus; or else, that the Heart's Force is increased with a greater Thickness of Blood, or a greater

Rigidity of the Artery. A quick Pulse denotes some Stimulus, or Obstacle, or greater Sensibility or Irritability of the Heart.

It is best felt where the Artery lies exposed bare to the Touch upon some resisting Bone; but Obstructions sometimes render the Pulse perceptible where it is never so naturally.

The Pulse is slower in Animals as they are larger, or more bulky; because the Heart is proportionably bigger in the smaller than in the larger Animals, and because the Heart is obliged to drive the Blood to a greater Distance; whence the Resistances, or Frictions, seem to be increased, in the more bulky, over the Force of the Heart. Hence small Animals are more voracious, and large ones, as the Whale and Elephant, eat less.

The Pulse of a healthy Person, rising in the Morning, beats 65 Times in a Minute; but, after the Fatigue of the Day, it will, in the Evening, beat 80 in the same Time: And, again, by the Night's Rest, or Sleep, it will become gradually slower, till, in the Morning, you will find it returned again to its primitive Number 65. For the voluntary Motion of the Muscles, and Actions of the external and internal Senses, urge the venal Blood on to the Heart; which, being thereby often stimulated, makes more frequent Contractions.

This is the Cause of those Paroxysms or Fits of Increase, observable in all Fevers towards the Evening. For Sleep not only retards the Motion of the Blood, but of all the other Humours and Actions in the Body whatever.

Dr. HALES ingeniously observes, that the Pulse is quicker in small Animals, and slower in larger. In his *Hæmastatics*, he found the Pulse of a Horse slower, by Half, than in a Man; viz. 32 Pulsations, only, in a Minute; whereas, in a Dog, the Pulse beat 97 Times in the same Space, and in a Sheep

Sheep 65; that is, about the ſame Number as in a Man ſleeping.

This, we find, is conformable to the Heat of the Blood, as meaſured by the Scale of FARENHEIT's mercurial Thermometer, as the late Dr. GEORGE MARTIN has ingeniouſly obſerved.

For the Blood in Oxen, Horſes, and other large Animals, at Reſt, being five or ſix Degrees cooler than in Man, will not riſe to our Heat, that is, 96 Degrees, but by a tolerable Degree of Exerciſe or Labour, which they can thus better endure: Whereas Dogs, Cats, and Fowls, are five or ſix Degrees hotter than Men; and the latter, when ſitting on their Eggs for Young, are ſtill four or five Degrees hotter, that is, 107 or 108 Degrees, which is commonly the Heat of our Blood in a Fit of the Ague; where it is obſervable, that, during the greateſt Senſe of Cold, the Blood is three or four Degrees hotter than in Health; after which, it gains four or five Degrees more in the Height of the hot Fit; viz. 104 or 105 Degrees: But, in violent ardent Fevers, where the Pulſe beats 140, the Blood's Heat will ſtill be four or five Degrees higher, viz. 110; that is, two or three more than equal to a ſitting Hen or Pigeon, and within three Degrees of the Heat that ſcalds a delicate or tender Hand.

But ſuch a Heat is in no Danger of hardening, but of putridly diſſolving the Blood or Serum, which BOERHAAVE miſtook, in his Chemiſtry: For to indurate Serum, or the Whites of Eggs, takes near 90 Degrees more of Heat.

Nor is the pleuritic or inflammatory Cruſt cauſed by a greater Heat, but from a greater Stagnation of the Blood in ſome Veſſels, whiſt it returns faſter through others; by which the lymphatic and ſerous Globules, with the nutritious Glue, retaining leſs Motion from their leſs Denſity, run into filamentary Concatenations and Cohesions.

The Pulse is more quick or frequent in Children as they are younger, and becomes afterwards slower in Persons as they grow older. The falient Point of an Ovum beats 134 Times in a Minute; the Pulses of new-born Infants beat 120 in the same Space of Time; and from thence, down to old Age, it grows slower, to 60 in a Minute.

A feverish Pulse begins from 96 per Minute; and we reckon the Pulse has but a moderate Celerity in Fevers, or laborious Exercifes of adult Persons, if it does not exceed 110 or 120 in a Minute; but it is excessive at 130 or 140, which is the Number of Pulses with which a Man dies.

The Pulse beats slower in Winter, and quicker in Summer, by about 10 Strokes per Minute; and under the Torrid Zone it grows quicker, to 120. The different Passions of the Mind variously accelerate, retard, and disturb, the Pulse.

We are to observe, that the Blood's Heat, or Velocity, are neither of them in Infants, in all Cases, proportionable to the Quickness of the Pulse; but the Density or Proportion of Crassamentum in the Blood, with more Magnitude of the Pulse, or Distension and Elasticity of the Arteries, must concur; the Defect of which is a Balance to the great Celerity of the Pulse in Infants, which would otherwise be the Cause of a high Fever in them, as well as in Adults. As they generate their Blood themselves, when in the Uterus, and receive none from the Mother (as some thought), the largest Globule which creates the Heat, and is the Cause of Elasticity of their Vessels, are at first inconsiderable; and as these advance by Age, the Celerity of the Pulse abates; whence Heat, and Velocity of the Blood, are continued nearly the same. Dr. MIHLES ON HALLER'S *Physiology*.



LECTURE XXIII.

Of the Force of the HEART, Contraction of the ARTERIES, Gravity and Attraction of the CAPILLARY TUBES, considered as Causes of the Circulation of the Fluids in the small Vessels of Animals*.

THE principal Cause which propels the Blood through the Vessels, is, without doubt, the Contraction of the Heart. Let us then, first, enquire, How far this may be supposed sufficient to account for the Motion of the Fluids in the very small Vessels of Animals?

If the Force with which the Blood is thrown, by the left Ventricle of the Heart, into the Aorta, be supposed equal to the Pressure of a Column of Blood 90 Inches high†, the Momentum of this Fluid, in an Artery, will be found, by multiplying the Area of the transverse Section of that Ar-

* This Essay I found so ingenious and probable, that I could not help extracting it from the learned WHYTT's Physiological Essays.

† Dr. HALES, from a Variety of Experiments made on Horses, Dogs, Sheep, and other Animals, thinks it probable, that the Blood would rise seven Feet and a Half, or 90 Inches, in a Tube fixed into the carotid Artery of a middle-sized Man. Statical Essays, Vol. II.

tery into 90, the Height of that Column of Blood, whose Pressure is supposed equal to the protrusive Force of the Heart; for the Product gives the Number of cubic Inches, or Parts of a cubic Inch, of Blood, whose Weight is equal to the pressing Power with which the Blood is driven, by the Force of the Heart, into that Artery.

The Diameter of a circulating red Globule of Blood has been generally reckoned somewhat less than a three Thousandth Part of an Inch; but Dr. MARTIN has, from LEWENHOECK's and JURIN's later Observations, shewn it to be $\frac{1}{19335}$ th Part of an Inch*: And LEWENHOECK has observed, that one of these Globules is sometimes obliged, in passing through a very small capillary Artery, to change its Figure into an oblong Spheroid; so that the Diameter of such an Artery may be supposed nearly equal to that of a red Globule. If, then, for the Sake of a more easy Computation, we suppose the Diameter of a red capillary Artery to be equal to a two Thousandth Part of an Inch; the Area of its transverse Section will be equal to 0.000000196; and this, multiplied by 90, gives 0.0000176 Parts of a cubic Inch of Blood; which amounts to 0.00466 or the 214th Part of a Grain†; and is equal to the Moment of the Blood arising from the Force of the Heart, in a capillary Artery whose Diameter is the two Thousandth Part of an Inch; upon a Supposition that there were no Loss of Motion from Friction, and that the Areas of the transverse Sections of all the capillary Arteries in the human Body were equal to that

* Medical Essays, Vol. II. Art. vii.

† A cubic Inch of warm Blood is reckoned, by some, to be 266; and, by others, a little more than 267 Grains: But Dr. MARTIN seems to have fixed it, pretty accurately, at 264 three Fourths; and, for the Sake of even Numbers, I have supposed it to be 265 Grains.

of the Aorta. But since this is not the Case, and the Areas of the former greatly exceed that of the latter; the Moment of the Blood, in a capillary red Artery, will fall very much short of our Computation.

To illustrate this; Let us suppose a Pipe A , of an Inch Diameter, to be divided into several Branches, and at last to terminate in 10000 small Tubes a, a, a, a , &c. each a Hundredth Part of an Inch in Diameter, the Sum of the Areas of whose transverse Sections is equal to that of A : If a Fluid be pushed through such a System of Vessels, with any given Force, the Velocities in the small Tubes a, a, a, a , &c. will be equal to the Velocity in A ; and their Momenta m, m, m, m , &c. all taken together, will, allowing for Friction, be just equal to the Momentum M , in the large Trunk A ; i. e. $m \ 10000 = M$, or $m = \frac{m}{10000}$. But if another Pipe B , of the same Diameter with A , be divided so as to terminate in 300000 small Tubes b, b, b, b , &c. each a Hundredth Part of an Inch in Diameter; then, altho' a Fluid be pushed through the two Trunks A and B with the same Velocity, and, consequently, the Momentum in them be equal; yet the Velocity, in any one of the small Tubes a, a, a, a , &c. will be to the Velocity in any one of the corresponding Tubes b, b, b, b , &c. as 30 to 1; and, consequently, their Momenta will be as 900 to 1.

Dr. KEILL having, by measuring the Arteries of the human Body, fixed the Proportions of the Branches to their Trunks after every Division, lays down a Method of calculating in what Degree the Velocity of the Blood, in the different Arteries, is affected by the Increase of the Capacity of the Vessels through which it flows*. According to

* KEILL's Tentamen Med. Phys. 2,

this Computation, it will be found, that the Velocity of the Blood, in an Artery whose Diameter is a two Thousandth Part of an Inch, ought to be to its Velocity in the Aorta, as 1 to 345; and, consequently, the Moment of the Blood, in such an Artery, must be 345 multiplied by 345, equal to 119025 Times less than we have computed it above; i. e. $= \frac{1}{214} \times 119025 = \frac{1}{25471350}$ Part of a Grain. And since a Globule of red Blood weighs nearly $\frac{1}{50000000}$ Part of a Grain*, it follows, that the Moment, or pressing Force, of such a Globule in its capillary Artery, arising from the Impulsion of the Heart, does not exceed twice its own Weight.

But even this Moment, however small it may appear, must be diminished by Friction; the precise Quantity of which, although it may, perhaps, be difficult, with any Certainty, to determine; yet, that it must be very considerable, will evidently appear, from what follows.

If two Pipes, of equal Lengths, whose Diameters are $\frac{372}{1000}$ and $\frac{90}{1000}$ Parts of an Inch, be, one after another, screwed into the Side of a Vessel at the perpendicular Distance of four Feet from the Top of the Water, and laid parallel to the Horizon; the large Pipe will discharge 179, and the small Pipe $6\frac{1}{8}$ Ounces of Water, in Half a Minute. Hence the Velocities of the Water, in these two Pipes, must have been as 1293 and 756; and, were it not for the Inequality of the Resistance of the Air, the Velocity in the large Pipe would have been still greater, and the Velocities in the two Pipes very nearly as the Square Roots of their respective Diameters†.

* Medical Essays, Vol. II. Art. VII. § II.

† ROBINSON'S Animal Oeconomy, Prop. I. Exp. 2.

Hence,

Hence, if we could suppose a capillary Artery, of $\frac{1}{2000}$ Part of an Inch Diameter, to go off directly from the Beginning of the Aorta, without any intermediate Branchings; the Velocity of the Blood in it would be, *cæteris paribus*, to the Velocity of the Blood in the Aorta, nearly, as $\sqrt{\frac{2}{0.0005}}$, the Diameter of the capillary Artery, is to $\sqrt{\frac{2}{0.7}}$, the Diameter of the Aorta, i. e. as 1 to 37.4; and, consequently, the Moment of a single Globule in such a capillary Artery, would be to its Moment in the Aorta, as 1 to 1398.

But farther: The Loss of Motion from Friction depends not only upon the Smalness of the Vessels, but also upon their Distance from the Heart. For if two cylindrical Pipes, whose common Diameter is $\frac{3.45}{1000}$ Parts of an Inch, and whose Lengths are 2 and 8 Feet, be screwed into the Sides of a Vessel full of Water, at the Distance of four Feet from the Top; the Quantities discharged in Half a Minute will be $97\frac{1}{2}$ Ounces by the long Pipe, and 175 Ounces by the short one. Hence the Velocities of the Water, in the two Pipes, were as $97\frac{1}{2}$ and 175; so that, by the greater Quantity of Friction in the longest Pipe, the Water lost above $\frac{2}{5}$ of its Velocity*.

Again; the Velocity of the Blood will be different, according to the different Angles at which the Branches go off from their Trunks, and the Flexures and Convolutions of the small arterial Ramifications must increase the Friction in them, and, consequently, retard the Motion of the Blood considerably. This seems to be confirmed by an Experiment of Dr. HALES; from which it appears, that the Velocity of the Blood, in the small Arteries, decreases in a greater Proportion than it

* Ibid. Prop. I. Exp. 1.

ought to do, by the above-mentioned Experiments made with strait cylindrical Pipes. For having slit up the Intestines of a Dog from one End to the other, on the Side opposite to that where the Blood Vessels enter them, and fixed a Brass Tube into the descending Aorta; he found, that, with a Pressure equal to the Force of the Heart, only $\frac{1}{3}$ of the Water passed, in a given Time, through the slit Arteries of the Intestines that flowed thro' the Mesenteries, when cut over just at their Entry into the Guts; notwithstanding the Areas of the Orifices of all the former exceeded that of the latter, and the Diameters of the cut Mesenteries did not exceed four Times the Diameters of the converging slit Arteries of the Guts*.

From what has been said it may appear, that the Velocity of the Blood will not be the same in all the Arteries of the same Diameter (as some have fondly imagined, and been at no small Pains to prove); but will be greater or less, according to their Distance from the Heart, the Excess of the Areas of the Branches above their Trunks, the Angles at which they go off, and the Number and Degree of their Flexures.

Agreeably to this, Dr. HALES observed, that, in a capillary Artery of the Lungs of a Frog (where the Distance from the Heart is but small, and the Excess of the Areas of all the Branches above their Trunk is not near so great as in the other Parts of the Body), the Blood moved 43 Times faster than in a capillary Artery of one of the Muscles of the lower Belly†. And it is probable, that, next to the Lungs, the Blood moves quickest through the Vessels of the Heart. In

* HALES's Statical Essays, Vol. II. Exp. IX.

† Ibid. p. 68.

Consequence of this quick Circulation, it must be evident, whether we suppose animal Heat to arise from the Friction of the Blood upon the Sides of the Vessels, or from an intestine Motion among its small Particles, that, *cæteris paribus*, more Heat must be generated in the Lungs and Heart than any-where else; and hence the Necessity of continual Supplies of fresh Air to cool the Blood in its Passage through the pulmonary Vessels.

Nor is this Opinion founded on Theory alone: For, upon Trial, it will appear, that the greatest Heat in any Animal is, almost always, about the Heart.

In a Jackdaw the Heat below the Wing made the Mercury in my Thermometer rise to 104 Degrees of FARENHEIT'S Scale; within the Intestinum Rectum it rose to $107\frac{1}{2}$; and, when applied to the Heart, it reached 109. And, agreeably to this, I have found the Heat in a Pigeon's Heart above a Degree greater than that within the Intestinum Rectum.

Upon the Whole, if the Moment of a single red Globule of Blood, arising from the pressing Force of the Heart, does not, in its capillary Artery, even abating Friction, exceed twice its own Weight, or $\frac{1}{25471350}$ Part of a Grain; and if that Loss of Motion, which it must have sustained by Friction, in its Way from the Heart thither, be considerable, as one may reasonably conclude, from what has been advanced upon this Head; it will follow, that the real remaining Force of such a Globule, when it arrives at a red capillary Artery, may, probably, fall short of its own Weight; and must be so extremely small, that it can scarcely be supposed sufficient to overcome the Resistance it must meet with in passing through a Vessel by which it is closely embraced on all Sides, although the

the anterior Fluid in the capillary Veins were no Obstacle in its Way.

I desire it may be here understood, that the above Calculations are by no means intended as Demonstrations, but rather as Illustrations, in the present Argument concerning the Force of the Blood in the smaller Vessels: And, allowing that by them the Moment of a red Globule, in its capillary Artery, comes out too small, either from our having, with Dr. HALES, rated the general Force in the left Ventricle of the Heart too low; or, with Dr. KEILL, the Number of Branchings of the Arteries, and the Proportion they bear to their Trunks too high: Yet it must be evident, that, in the inferior Orders of Vessels, the Fluids cannot be propelled by the Power of the Heart; or, which is the same Thing, that the left Ventricle of the Heart does not, by its direct projectile Force at every Contraction, push on and move forwards the whole circulating Fluids in all the Vessels of the Body.

Dr. HALES * observed the Blood's Motion accelerated by every Systole of the Heart, not only in the small Arteries, but also in the nascent capillary Veins, of the Lungs of a Frog; and LEWENHOECK assures us, he has seen the same Thing in other Parts of various Animals: So that it is not to be doubted, that the projectile Force of the Heart reaches, at least, as far as the capillary Arteries of the first Order; nay, is probably continued, for some small Way, along their corresponding Veins; especially when these are not far from the Heart.

* Statical Essays, Vol. II. p. 69.

But that the Moment of the Blood in the red capillary Arteries, at any considerable Distance from the Heart, must be very small, will appear, from an Observation of Dr. HALES; according to which, the Velocity of the Blood in one of these Arteries, in the Abdomen of a Frog, was near 900 Times less than the equable Velocity of this Fluid in the Aorta of a Man*; and, consequently, 2.6 Times less than we have computed it to be in a human red capillary Artery: Wherefore the Excess of the Moment of a red Globule, in such an Artery of a Frog, above the Resistance it had to overcome, only amounted to $\frac{1}{17334000}$ Part of a Grain; and so must have fallen a good deal short of $\frac{1}{3}$ of its own Weight, supposing the Globules of red Blood in a Man and a Frog to be of the same Magnitude; which does not seem improbable†.

If, then, the remaining Moment of a red Globule of Blood in its capillary Artery, after having overcome the Resistance of the Blood in its corresponding Vein, does not amount to $\frac{1}{3}$ of its own Weight; it must be evident, that the serous and smaller Globules, which move along with the red ones, must be applied, by the projectile Force of the Heart, to the Orifices of the lateral serous Arteries with a very inconsiderable Force; such a one, surely, as will be far from being able to push these Fluids through the serous, lymphatic, and, for any Thing we know, many more inferior Orders of Vessels.

But, to set this Matter in a still stronger Light, we shall, upon the Principles above laid down, endeavour to investigate the Force of the Heart at the Origin of the Nerves.

* Statical Essays, Vol. II. p. 47, 68.

† Medical Essays, Vol. II. Art. vii & v.

LEWENHOECK tells us, that he discovered Vessels, in the cortical Part of the Brain, which could not admit a Globule of Blood whose Diameter was $\frac{1}{128000}$ Part of an Inch^{*}; and he observed the Fibres of its medullary Substance to be either quadrangular or hexangular: Whence he concludes, that they must be composed of smaller Fibrillæ, whose extreme Minuteness made it impossible for him to discover any Thing of their Figure. Nor does he think they can ever be seen distinctly by human Eyes†.

Dr. PORTERFIELD has, indeed, from an Experiment of Dr. HOOK, computed the Diameter of a single nervous Fibre to be $\frac{1}{21000}$ Part of an Inch||. But as the best Microscopes have never been able to discover any Cavities in the Nerves, it is certain, that, if they are hollow Tubes at all, the Diameters of their Cavities must be a great deal less than this, and, perhaps, fall short of $\frac{1}{200000}$ Part of an Inch. For a Microscope, which magnifies the Diameter of an Object 800 Times, would, upon this Supposition, make the Cavities of the Nerves appear equal to a Point whose Diameter is $\frac{1}{50}$ Part of an Inch, which is an Object that may be discovered by a good Eye.

LEWENHOECK, it is true, towards the End of his Days, and when more than Eighty Years old, pretended, more than once, to have seen Cavities in the Nerves very distinctly: But it happens unluckily, for this Discovery, that no Body has been able to confirm it since his Death. Nor could he, when alive, though he saw these Cavities himself, shew them to any one else; as appears, from the following Passage in his xxxiii^d Epistle. “ Id
“ unum in hoc negotio male me habet, quod

* De Cerebro, p. 35.
Essays, Vol. IV.

† Epist. xxxiv.

|| Medical

“ Cavi-

“Cavitates illas nemini possum conspicuas exhibere; nam simulac illas Oculis meis examinandas admoveo, illico & minuto citius per exsiccationem concedunt.” But if the ultimate Fibres of the Medulla Oblongata were so fine, that he could discover nothing of their Shape or Figure, as he himself confesses; it will not be thought probable, that he could discover the Cavities of the Nerves, which seem to be a Production of these, and, at least, equally subtil with them.

But lest any one, unaccustomed to Speculations of this Kind, should think the Motion of a Fluid through such vastly subtil Vessels as the Nerves, almost impossible; let him reflect a little on the infinite Divisibility of Matter, and, particularly, on the extreme Ductility of Gold, which may be drawn over Silver so as the Thickness of the Skin of Gold (in which, however, the best Microscope cannot discover the smallest Pore) shall not amount to $\frac{1}{12000000}$ Part of an Inch*; i. e. a sixtieth Part of what we suppose the Diameter of the Cavity of a Nerve may be. So that the Particles of such a Leaf of Gold, swimming in a Fluid, might pass more easily through the Nerves, than a single Globule of red Blood does through its capillary Artery.

Farther; a Bubble of soaped Water, when managed after Sir ISAAC NEWTON's Method, exhibits, just before it breaks, a black Spot upon its superior Part; the Thickness of which, according to his Theory of Light and Colours, scarcely exceeds $\frac{1}{3000000}$ Part of an Inch. Hence we see, that a Fluid, composed of Soap and Water, i. e. of alkaline Salt, Lime, Oil, and Water, may be divided, by human Art, into Parts whose Dia-

* Memoires de l'Acad. des Sciences, ann. 1713.

meter is fifteen Times less than that which we have assigned to the Nerves; and, consequently, that such a compound Fluid might easily pass through their Cavities.

Let us, then, suppose the Diameter of the Cavity of a Nerve to amount to $\frac{1}{200000}$ Part of an Inch, and the Area of its transverse Section will be 0.0000000000196; which, multiplied into 90 (the Height of a Column of Blood whose Weight is supposed equal to the pressing Force of the left Ventricle of the Heart), gives 0.00000000176 Parts of a cubic Inch of Blood, or $\frac{1}{2140000}$ Part of a Grain; which would be equal to the Moment of the animal Spirits, at the Origin of the Nerves, arising from the impulsive Force of the Heart, if there were no Loss of Motion from Friction, and if the Area of the transverse Section of the Aorta was equal to the Areas of the transverse Sections of all the extreme capillary Vessels in which the numerous Branches and Ramifications, derived from the Aorta, at last terminate. But, if we consider how greatly the latter must exceed the former, and, upon Dr. KEILL's Principles, enter into a Computation of the Effect which this must have upon the Motion of the nervous Fluid; we shall find, that its Velocity will be to that of the Blood in the Aorta, nearly, as 1 to 20000; and, consequently, the Moment of the nervous Fluid, arising from the protrusive Force of the Heart, will be only equal to $\frac{1}{2140000} \times \frac{1}{40000} = \frac{1}{85600000000}$.

If we imagine a Sphere to be composed of the Particles of the nervous Fluid, whose Diameter is equal to the Diameter which we have assigned to the Cavity of a Nerve; then, taking its specific Gravity to be the same with that of Water, its Weight will amount to $\frac{1}{45228780325014}$ Part of a Grain; i. e. near 19 Times more than the Force
with

with which it is pushed forward by the Contraction of the left Ventricle of the Heart; even upon the Supposition that it had met with no Resistance from Friction in its Passage through the small Vessels of the Brain. Hence the Moment of a small Sphere of animal Spirits, in a Nerve, is 38 Times less, in Proportion to its Weight, than the moving Force of a Globule of red Blood in its capillary Artery; and the Difference of their Forces will be still greater, in Proportion to the Resistance which each has to overcome; since the Resistance to the Motion of a Fluid, from Friction, must be, *cæteris paribus*, as much greater in the Nerves than in the red capillary Arteries, as the Diameter of the latter exceeds that of the former.

But farther; since the longer any capillary Vessel is, the more will the Motion of a Fluid be retarded, and, consequently, its Force be diminished in it. It is easy to see, that in the Nerves, whose Cavities are so inconceivably small, but whose Length is generally very considerable; the Force of the Heart, which we have shewn to be surprisingly little, must be altogether unable to overcome the Friction; nay, even the mutual Attraction of Cohesion between them and their Fluid, and, consequently, be of itself, and when unassisted by any other Power, wholly insufficient to propel the animal Spirits to all the different Parts of the Body; and this even upon a Supposition that the Nerves were continued directly from the extremely minute capillary Arteries. But if we consider how much the Force of the Blood must be broken in passing through the infinitely convoluted and amazingly fine Vessels of the cortical Part of the Brain, together with the Follicles in which these are imagined (by some) to terminate; what we have been contending for, will appear still more evident.

Lastly, The above Reasoning receives additional Weight from those Experiments which shew that the Brain may be nourished, perform its Office, and afford a sufficient Supply of Spirits for carrying on all the vital and animal Functions, altho' the Blood is pushed by the Heart into its Vessels with a great deal less Force than usual.

Thus the learned Dr. Van SWIETEN informs us, That he tied both the carotid Arteries of a Dog, without any observable Inconvenience to him : On the contrary, he continued twelve Days healthful and lively. After which Time, he opened his Skull, but could discover nothing preternatural in the Brain*.

Now as in this Dog the Brain could only be supplied by the vertebral Arteries which inosculate with the Carotids; the Velocity, and, consequently, the Moment of the Blood, must, at the same Time that it was considerably lessened in the Ramifications of the former, have been so remarkably diminished in those of the latter, by reason of the Smalness of the Branches with which they communicate, compared with the Trunks of the Carotids, as to shew, beyond Doubt, that the Secretion of the nervous Fluid, and its Derivation to the several Parts of the Body, do not depend so much upon the Force of the Heart as has been generally imagined; but must be, in a great measure, owing to some other Cause.

Having shewn how inconsiderable the Moment of the Fluids, arising from the projectile Force of the Heart, must be, in the inferior Orders of Vessels, and particularly at the Origin of the Nerves; we come now to take a View, somewhat different, of the Matter, and to compare the real Force of

* Comment. in BoERH. Aphor. Vol. I. p. 266.

the left Ventricle of the Heart with the Obstacles it has to overcome, upon a Supposition that, at each Systole, it pushes forward the whole circulating Fluids in all the Arteries and Veins of the Body.

BORELLI computed the Resistance which the Blood meets with, in circulating through all the Vessels of the human Body, to be equal to 180000 Pounds Weight*. But though this be over-rating the Matter very much; yet, after all the Abatements that can be reasonably allowed, there will remain a Resistance by much too great to be overcome by the Force alone of the left Ventricle of the Heart; a Force which cannot, in Man, amount to 60 Pounds Weight†; as far as can be gathered from the latest and best Experiments which have been made on other Animals, in order to determine the pressing Power of the Heart. Yet, inconsiderable as this Force is, it is not to be regarded as that communicated to the Blood in the Aorta, but only as the Pressure or Weight sustained by the whole internal Surface of the left Ventricle of the Heart, just when it begins to contract; and the Force with which the Blood is impelled into the Aorta, will (since Fluids press equally unde quaque) bear no greater Proportion to this than the Area of the Orifice of the Aorta does to the whole internal Surface of the left Ventricle of the Heart; i. e. supposing the Area of the Orifice of the Aorta equal to one Fifth of a square Inch: and the internal Surface of the left Ventricle (equal to 15 square Inches ||) as 1 to 30: And therefore

* De Motu Animal. Part. II. Prop. 73.

† Dr. HALES makes it only 51 Pounds. Statical Essays, Vol. II. p. 40.

|| HALES loc. citat.

the Force with which the Blood is pushed into the Aorta must fall short of one 30th Part of 60 Pounds Weight. Hence a Resistance in the Aorta, equal to two Pounds, will require a Force of above 60 Pounds, excited by the whole internal Surface of the left Ventricle of the Heart to overcome it : From which it follows, either that the Resistance to the Motion of the Blood in the Aorta, and all its Branches and Ramifications must be less than two Pounds, which I believe no Body will affirm; or else, that the protrusive Force of the left Ventricle of the Heart, alone, is unable to drive the Blood through all the Vessels; and, consequently, insufficient, without the Assistance of some other Power, to carry on the Circulation.

If any one should, on this Occasion, have Recourse, with the learned BORELLI, to the *Vis Percussionis*, we need only observe, that the Force of the Heart is, evidently, not a percussive, but a pressing one: So that, altho' the least percussive Force may be greater than any finite quiescent Resistance; yet this will not hold true of a pressing Force; which, in order to have any sensible Effect, must be greater than the Resistance it has to overcome. To say otherwise, is to affirm, that, with the pressing Force of one's Hand, the greatest Mountain might be moved out of its Place.

Nor is Dr. KEILL's Account of this Matter more satisfactory; viz. that, the Blood being once put in Motion, a very small Force, in the Heart, may be sufficient to keep it always in this State: For this Force must be equal to the Loss of Motion sustained by the Blood, in every Circulation, and, consequently, to the Resistance which this Fluid meets with in its Passage through all the Vessels of the human Body; a Resistance too great to be balanced by the few Ounces to which the
 Doctor

Doctor has reduced the Force of the left Ventricle of the Heart*.

But that the Foundation, upon which Dr. KEILL proceeds, is false; and that the Heart can really communicate a new Motion to the Blood, when the old one is, in a great measure, lost; and after all the Fluids have been, for some Time, almost entirely at a Stand; is evident, from the Recovery of People who have lain, for some Time, in a Syncope; and from the Revival of sleeping Animals, which are, in Appearance, dead all the Winter-season.

But farther; since the Blood, when it returns to the right Ventricle of the Heart, has scarce one Tenth of the Force with which it was thrown into the Aorta†; it is plain, that it acquires, every Circulation, nine Tenths of its Force in passing through the Heart and Lungs.

Thus much being said to shew that the Force of the Heart is, of itself, not sufficient to carry on the Circulation; we shall next briefly consider the alternate Contraction of the Aorta and its Branches, which has been justly reckoned among the chief Causes of the Motion of the Blood.

The Blood thrown out, at every Systole, by the left Ventricle of the Heart, is not instantly transmitted through the capillary Arteries into their corresponding Veins; but the greatest Part of it is accumulated in the now dilated Arteries, and is, during their succeeding Contraction, conveyed on through the smaller Vessels. This Contraction, however, of the Arteries, may, perhaps, be considered rather as a Continuation of the Heart's Force, than as any new Power impressed on, or communicated to, the Blood; since it does not ap-

* Tentam. Med. Phys. 3. de vi Cordis.

† HALE'S Statical Essays, Vol. II.

pear, that the Arteries contract with a greater Force than that by which they were dilated. But, whatever may be the Force with which the Aorta and its Branches restore themselves, we know certainly, that it is less than the systolic Power of the left Ventricle of the Heart; because the Blood is observed always to be projected to a greater Distance from a cut Artery, during its Diastole, than in the Time of its Systole. Whence it follows, that, if the Force of the Heart is insufficient to account for the Motion of the Fluids through the inferior Orders of Vessels, the alternate Contraction of the muscular Coat of the Aorta and its Branches must be so likewise.

It is, however, to be observed, that the sanguiferous Arteries, whose numerous Branches are dispersed every where through the Body, must not only, by their alternate Contraction, contribute to push forward their contained Fluids; but also, by their Dilatation, so compress the inferior Orders of Vessels, as somewhat to promote the Motion of the Fluids in them*.

I shall only add, on this Head, that, as the alternate Contraction of the Arteries depends entirely upon their preceding Dilatation by the Heart; so, in the serous and inferior Orders of arterial Vessels, to which the projectile Force of the Heart seems not to reach, there is no such alternate Dilatation and Contraction to be observed†.

With Respect to Gravity, which some have reckoned among the Causes promoting the Circulation, it is sufficient to observe, that, in a horizontal Position of the Body, it can have no Effect; and, in an erect one, it must retard the Return of the Blood, by the Vena Cava Inferior, as much as

* See Medical Essays, Vol. V. p. 2. Edit. III. p. 39.

† LEWENHOECK. *Epist.* LXX. p. 167.

it promotes its Motion downwards in the Aorta and its Branches.

There is scarcely any Thing that will sooner or more naturally strike the Mind of one who enquires into the Causes of the Motion of the Fluids, in the very minute Vessels of Animals, as well as Vegetables, than that surprising Power of attracting Liquors which capillary Tubes are endowed with. But although the attractive Power of such Tubes may assist us in accounting for the Imbibition of Fluids by the Vessels commonly called Absorbents, as we shall afterwards have Occasion to shew; yet it must appear evident, to every one acquainted with the Phænomena of these Tubes, that this Attraction can be of no Use in promoting the Circulation of the Blood in the capillary Arteries and Veins, since these Vessels are always full; or, if they were not, the Fluids would be determined by it, equally backward towards the larger Arteries, as forward to the Veins.

THAT THE VIBRATORY MOTION OF THE SMALL VESSELS OF ANIMALS IS THE PRINCIPAL CAUSE PROMOTING THE CIRCULATION OF THE FLUIDS. From the same Author.

Having shewn the Insufficiency of the Powers, already mentioned, to account for the Circulation of the Fluids in the very small Vessels of Animals; we shall now proceed to explain what we imagine to be the principal Cause of this Circulation.

Although, as has been observed above, the regular alternate Pulsation of the Arteries does not extend beyond the Capillaries of the first Order, except, perhaps, in Places very near the Heart; yet we are not to consider the serous, lymphatic, and other still smaller Vessels, as inactive Canals,

no ways contributing to promote the Circulation of their different Fluids: On the contrary, it seems highly probable, that these Vessels are continually agitated with very small alternate Contractions, to which the Circulation in them is, in a great measure, owing.

Many physiological Writers have supposed an oscillatory Motion in the small Vessels of Animals, but few have said any Thing satisfactory concerning the Cause of this Motion.

BAGLIVI supposed the membranous Parts of the Body to derive their Oscillations from the Dura Mater, and the vascular System and fleshy Fibres theirs from the Head: But as it is known, beyond doubt, that the Dura Mater has no other Motion than what arises from the Pulsation of its own Vessels, or those of the Brain; and as the alternate Contractions of the Arteries depending upon their preceding Dilatation by the Blood thrown out by the Heart, has no Place in the serous, lymphatic, and inferior Orders of Vessels; the vibratory Motion of these Canals must be deduced from some other Cause.

Many Experiments and Observations shew, that the muscular Fibres of Animals are so framed, as to be readily excited to Contraction by a Stimulus. The small Vessels, therefore, which are endowed with a muscular Tunic, as well as the larger ones, must necessarily be agitated with alternate Contractions, as often as they are acted upon by any Thing capable of gently irritating them; but such are the Blood and finer Fluids derived from it, which, while they slowly glide through the small Vessels, stimulate their internal Surface, so as to excite them to gentle, but continually repeated Contractions.

Some of the greatest Philosophers and Physicians, of antient as well as later Times, have ima-

imagined the Blood to be a very active Fluid, endowed with uncommon Qualities, and, as it were, the Fountain and Source of Life in Animals : Nor do they seem to have been led into this Opinion so much from any favourite Theory, as from Experiments and Observations made on living and dying Animals.

But, without entering into, much less defending, the peculiar Notions of these Authors concerning the Blood, we shall only say, that this Fluid is extremely well fitted to act, as a gentle Stimulus, upon the sensible Fibres of Animals, whether we consider its Composition, Heat, or intestinal Motions. For, while the saline and other acrid Particles in the Blood render it fit to irritate the tender Vessels, its Heat and intestinal Motion keep all its Parts in a perpetually vibrating State, which must increase their stimulating Power.

Agreeably to this, we find, that, in many Insects, and some larger Animals, the Circulation becomes more languid, as the Weather grows colder; and, in the Winter Season, is altogether at a Stand; till, by the Heat of the returning Spring, the Particles of the Fluids begin to be briskly agitated, and, consequently, the Solids stimulated to Contraction.

Dr. HARVEY has long since remarked, that the Hearts of several Shell Fishes are only seen to beat in warm Weather; and the curious Observations of DE REAUMUR have shewn us, that the Lives of Insects may be lengthened or shortened, and made more or less active, by exposing them to different Degrees of Heat and Cold.

Thus much being said to shew that the Blood is well fitted to act as a Stimulus, we shall offer some farther Considerations to prove, that the small Vessels are, by its Influence, really excited to alternate Contractions.

And,

And, 1. We are led to conclude this from what we observe in the larger Canals and Vessels of Animals. Thus the several Portions of the intestinal Tube are solicited to alternate Contractions by the Aliment, Air, and Bile, stretching their Tunics, and stimulating their internal Surfaces: And as we imagine an alternate Motion, in the small Vessels, necessary to promote the Circulation of the Fluids in them; so we know certainly, that the peristaltic Motion of the Intestines is the principal Cause which conveys the digested Aliment down towards the Anus.

Not only the Auricles and Ventricles of the Heart, but also the Trunks of the Venæ Cavæ adjoining to the right Sinus Venosus, are continually agitated with alternate Contractions. The Trunks of the Venæ Cavæ preserve this Motion in Animals, newly dead, a considerable Time after the Pulsation of the Heart has ceased; but no sooner is the Blood contained in these Vessels evacuated, and all new Supplies intercepted by Ligatures, than their Sides collapse, and remain without the smallest Motion. Whence we are led to conclude, that the alternate Contractions of these Veins are, like those of the Heart, owing to the Blood acting on them as a Stimulus.

It is generally allowed, by Physiologists, that the Systole of the larger sanguiferous Arteries, in which a remarkable Pulsation obtains, is owing not only to their Elasticity, whereby they endeavour simply to recover themselves; but partly, also, to a proper muscular Contraction of their tendineo-carnous Tunic: And, as this is excited by the Blood pushed into them by the Heart, which, at the same Time that it distracts their Fibres, gently irritates their internal Surface; it seems highly reasonable to allow, that the smaller Vessels, endowed at least with equal Sensibility, must
be

be excited to feeble, but continually repeated Contractions, by the gentle Stimulus of their circulating Fluids.

Farther: As there are some of the more imperfect Animals which have no Heart, the Circulation in them must be owing to the contractile Power of the Vessels themselves, excited to Action by the Stimulus of the Fluids: And that the Vessels of those Animals, which, in a natural State, have a Heart, are endowed with a similar Power, seems proved, by Examples of Monsters wanting a Heart, or any Thing analogous to it; in whom the Fluids must have circulated chiefly by the Power of the Vessels.

A great Variety of Facts might be produced, which clearly demonstrate an alternate contractile Power in the small Vessels of Animals; and that this is exerted, more or less, according to the Degree of Irritation affecting them.

Thus the Steams of warm Spirit of Wine, received into the Eye, not only cause a greater Flow of Tears from their Vessels; but, in a few Seconds, produce an artificial Inflammation in them; that is, they make the Globules of red Blood enter the ferous or lymphatic Vessels of the Conjunctiva. Now, as this additional Moment of the Blood, whereby it is enabled to dilate these Vessels, cannot proceed from the Heart or larger Arteries, since their Force is not, nor can be altered in the present Case; it must be owing to the extraordinary oscillatory Motion excited, in the Vessels of the Eye, by the Steams of the Spirit of Wine.

I presume it will not be alledged, that the Vapour of Spirit of Wine raises an Inflammation in the Eye, by constringing its Vessels, so as to occasion an Obstruction in them; and that this Obstruction afterwards produces the Inflammation, by lessening the Number of Vessels thro' which
the

the Blood passes; and, consequently, increasing its Force upon the obstructed ones. For, not to insist on what might be easily proved, that no Obstruction can ever produce an Inflammation except so far as it gives Rise to an unusual Irritation; the Spirit of Wine should, by constringing the ferrous and lymphatic Vessels of the Conjunctiva, enable them to sustain this additional Force.

But farther: Why does tepid Milk and Water, or a Poultrice of Bread and Milk, lessen an Inflammation of the Eye, while acrid, astringent, and spirituous Liquors, increase it? According to the Doctrine of Inflammations from mere Obstructions, together with an increased Force of the Heart and larger Arteries, one would think, that the former should, by reflecting the small Vessels, expose them to be still more and more dilated by the increased Force of the Blood, and so increase the Inflammation; while the latter should, by constringing those Vessels, enable them not only to resist the Blood impelled by the Heart, but also expel the obstructing red Globules. But the Truth of the Matter is, that the tepid Milk and Water, and Poultrice, by relaxing the Vessels, lessen or remove the Irritation and Sense of Pain, which, by raising uncommon Contractions in the small Vessels, was the Cause of the Inflammation; while acrid, astringent, and spirituous Applications, tho' they tend to constringe the Vessels, yet, by increasing their vibratory Contractions, greatly augment the Motion of the Blood in them; and therefore must necessarily increase the Inflammation.

The Heat, Redness, and Inflammation, brought on the Skin by Blisters and Sinapisms, are not owing to any Increase of the Heart's Force, or of the Moment of the Blood in the larger Vessels, though this is often an Effect of their Application;

tion; but merely to the Action of those irritating Substances on the cutaneous Vessels, whereby the Motion of the Fluids in them is greatly augmented.

The sudden Redness and glowing Warmth of the Face, which, in the Fair Sex especially, accompanies a Consciousness of Shame, and is commonly distinguished by the Name of Blushing, can only be satisfactorily accounted for from an increased oscillatory Motion of the small Vessels of the Face.

The extraordinary Flow of Saliva, which happens to hungry Persons from the Sight, or even the Remembrance, of grateful Food, and the profuse Secretion of Urine which hysterical People are frequently subject to, cannot be explained without having Recourse to an increased Motion suddenly excited in the small Vessels of the salivary Glands and Kidneys; and clearly shew, that the Quantity of Saliva and Urine, separated by these Organs, does not depend so much upon the Force with which the Blood is determined into their Vessels by the Heart, as upon the greater or lesser vibratory Motions of the secreting Vessels themselves. And, in the same Manner, is it not reasonable to believe, that the Motion of the Fluids in the smallest Vessels every-where through the Body, is as much, perhaps more, owing to their gentle alternate Contractions, than to the Force of the Heart and larger Arteries?

The Secretion of Tears, which is very little affected by the different Forces with which the Blood is impelled by the Heart, is immediately increased, in a very great Degree, by acrid Applications to the Eyes, or certain Passions of the Mind.

In the first Case, the greater Secretion is owing to the acrid Matter; which, by its Irritation, raises

an uncommon vibratory Motion in the lachrymal Vessels. Nor can it be, with Reason, objected here, that acrid Things, applied to the Eyes, or received into the Mouth, occasion a greater Flow of Tears, or Saliva, not by raising any stronger oscillatory Motion in the Vessels of the lachrymal and salivary Glands, but merely by constringing their excretory Ducts, and so squeezing out the Liquors contained in them; since the Quantity of Tears and Saliva, discharged in such Cases, shews, that not only the Excretion, but Secretion, in these Glands, is greatly increased. And if an Irritation of the Pelvis, Kidney, or Ureter, from a Stone lodged there, often occasions an uneasy Sensation in the Extremity of the Urethra; is it not reasonable to think, that, upon the Application of stimulating Things to the Orifices of the lachrymal and salivary Ducts, these will not be affected alone; but the Irritation will, in some Degree, be communicated to the small secreting Vessels of their respective Glands, so as to excite in them stronger and more frequently repeated Contractions, and, consequently, increase their Secretion.

The Flow of Tears, which accompanies certain Affections of the Mind, is, like the greater Secretion of Saliva from the Sight of grateful Food, and the Heat and Redness of the Face from a Consciousness of Shame, owing to an unusual vibratory Motion excited in the lachrymal Vessels in Consequence of these Affections, and not to any Compression which the lachrymal Gland may suffer from some of the adjacent Muscles which are then brought into Contraction: For no Degree of alternate Compression, applied to this Gland, remarkably increases the Secretion of the Tears, unless its Vessels, or those of the Eye, are thereby irritated.

We have already seen, that an increased oscillatory Motion, in the small Vessels, occasions a quicker Flow of Liquors through them : And the following short History will shew, that, when this Motion is much diminished, or wholly suspended, these Vessels collapse, and the Circulation in them either becomes very languid, or wholly ceases.

A Boy, between four and five Years of Age, was, one Saturday Afternoon, suddenly seized with an Apoplexy, or Abolition of Sense and voluntary Motion : On Sunday Morning, at Nine o'Clock, when I first saw him, his Pulse was full and quick, and his Eyes had somewhat of a glazed Look ; but, in the Evening, this was more remarkable : On Monday, a little before Noon, he was still alive, but his Breathing very laborious, and his Pulse small and quick : At this Time his Eyes were more shrivelled than they are used to be in those who have been several Hours dead.

This glazed Appearance of the Eyes could not be owing to the Diminution of the Heart's Force, since the Pulse was full and strong for twenty-four Hours after the Disease came on : Nor can the Failure of the Pulse, afterwards, account for the Shrivelling more than is usual in Persons newly dead. But if the Circulation of the Fluids in the small Vessels be chiefly owing to a vibratory Motion in them ; and if this must cease, when the Influence of the Nerves is intercepted ; in this Boy, whose Brain, especially its anterior Part, was so remarkably obstructed, the Motion of the Fluids in the very small Vessels of the Cornea, and the Secretion of the aqueous Humour, must have been greatly diminished ; and hence the Dimness and Shrivelling of the Eyes.

The withering of a Member that is palsied, or deprived of the nervous Power, is to be accounted for in the same Manner ; and is a Proof that the

Circulation of the Fluids through the inferior Orders of Vessels, is not so much owing to the Force of the Heart, as to the Action of these Vessels themselves.

This withering of a palsied Member has made some imagine, that Nutrition is performed by the Nerves: But the Phænomenon, we see, is easily accounted for, without this Supposition; and there are good Reasons to think, that the Nerves are solely subservient to Motion and Sensation.

Lastly, Although the alternate Contractions of the smaller Vessels, which we have been contending for, are not remarkable enough to be discerned in most Animals; yet they may be clearly seen in the Legs of a Bug; in the small Vessels of which, an extraordinary Vibration is discovered, by the Microscope.

The Objection against the Reality of a vibratory Motion in the small Vessels of Animals, because the Microscope shews no such Thing in most Animals, is of no great Weight, since it cannot be doubted, that the Particles of all Bodies, especially Fluids, are affected, by Heat, by perpetual oscillatory Motions; and yet, unless the Heat be great, the Eye, even assisted by the best Microscopes, cannot discern any such Thing.

Farther: Since the Microscope only shews the Circulation of the Fluids in the red capillary Arteries, but not in the serous, lymphatic, and many inferior Orders of Vessels; can it be expected, that any alternate vibratory Motion should be discovered in these Vessels? Or is it reasonable to deny an alternate Motion to all Vessels, or Particles of Matter, which are too small to fall under the Notice of our Senses?

Although the Branches of the Vine were transparent, so that the Motion of the Sap in its Vessels could be seen, by the Help of a good Microscope;

scope; yet, it is very probable, we should not be able to discover any vibratory Motion in them: And yet the Force of the Sap, in the bleeding Season, shews, that, besides Attraction, there must be a real propelling Power exercised by the Vessels of the Vine.

If the Diameter of the Aorta, in its Diastole, does not exceed its Diameter when contracted above one Fifth of a Line, i. e. one Fiftieth of its Diameter; and if the Change of Diameter, which happens, in the red capillary Arteries and inferior Orders of Vessels, from their vibratory Contractions, be three Times less, in Proportion to the Magnitude of these Vessels, than the Difference of Diameter in the Aorta, arising from its alternate Diastole and Systole; then the Difference between the greatest and least Diameter of a capillary Artery, capable of receiving only one Globule of red Blood, when most dilated or contracted, will be equal to a Hundred and fiftieth Part of its Diameter: i. e. Supposing its Diameter a two Thousandth Part of an Inch, equal to a three Hundred thousandth Part of an Inch; and the Space described by each Side of such an Artery, when it performs one of its small vibratory Contractions, will be only equal to a six Hundred thousandth Part of an Inch; which is greatly too small to be discerned by the best Microscope.

Having thus endeavoured, by a Variety of Arguments, to shew, that the small Vessels of Animals are, through the gentle Stimulus of the Fluids, continually agitated with alternate Contractions; we shall now briefly point out their Use in carrying on the Circulation. And it must appear evident, to every one, that the inferior Orders of Vessels will not only not retard the Motion of the Fluids, but greatly promote it; since every Ringlet of them will, like a little Heart, by its alter-

nate Contractions, push on its contained Fluids. Nor ought these Contractions, however weak and imperceptible, to be thought unable to produce this Effect; since the Motion of the Fluids, in the very small Vessels, is far from being rapid, and just such as might be expected to arise from this Cause.

Dr. HALES has observed, that, in a capillary red Artery in one of the Muscles of the Abdomen of a Frog, the Blood moved only an Inch in a Minute and a Half: And it is probable, that, in the finest secretory Vessels of the Brain, the Fluids may not move above a Parisian Line, or an Inch and a Half, in a Minute; i. e. not twice as fast as the Minute Hand of a small-sized Watch.

If it be objected, that, as the capillary Arteries and Veins are destitute of Valves, their alternate Contractions must push the Fluids equally back towards the Heart, as onwards to the larger Veins: It may be sufficient to answer, That the Resistance, arising from the semi-lunar Valves of the Aorta, and from the Force of the Heart and larger Arteries, à Tergo, being greater than that which opposes the Transmission of the Fluids into the larger Veins, the Fluids acted upon by the small vibrating Vessels, must necessarily be determined towards the latter.

But farther: Why may not the alternate Contractions of the small Vessels, like the peristaltic Motion of the Intestines, proceed in such a Manner, as to impel their Fluids more remarkably onwards to the Veins, than backwards to the larger Arteries?

Upon the Whole, as we conceive the Motion of the Blood in the larger Vessels, and even Capillaries of the first Order, to be owing to the alternate Systole of the Heart and Arteries; so, in the serous, lymphatic, and still smaller Vessels, where this Force either reaches not at all, or is greatly
dimi-

diminished, the Circulation seems to be carried on chiefly by the vibratory Motions of these Vessels themselves: And the finer Fluids being, in this Manner, transmitted to the larger Veins, the Pulsation of neighbouring Arteries, Action of voluntary Muscles, and alternate Compression made upon all the Contents of the Abdomen and Thorax, by the Motion of Respiration, will promote their Return to the Heart along with the red Blood in the Venæ Cavæ.

What we have said of the Circulation of the Fluids in general, we would have understood also of their Motion in the secretory Ducts of the several Glands. In those Glands whose Vessels are most patulous, the Secretion may be partly, and indeed in a good measure, carried on by the Force of the Heart and larger Arteries; a Proof of which seems to be, the bloody Urine passed by such as have weak Kidneys, after violent Exercise: But in other Glands whose Structure is finer, and, particularly, in the Brain, the Motion of the Fluids, in the secretory and excretory Vessels, seems to be much less owing to the Force of the arterial à Tergo, than to the gentle vibratory Contractions of the Vessels themselves.

With Regard to the Nerves, which are generally considered as the excretory Ducts of the Brain; it is probable, that the Derivation of their Fluid to the various Parts of the Body is not only owing to a gentle oscillatory Motion in them, and their surrounding Membranes, but also, in some Degree, to their Attraction as capillary Tubes: For no sooner can there be a Waste of this Fluid at the Extremity of any Nerve, whether this happens from Exhalation, alternate Compression of the neighbouring Parts, or any other Cause than by its attractive Power, it will be filled again. In the other Glands, however, whose excretory Ducts,

by their Union, soon form pretty large Canals, no such Attraction will have Place.

From what has been said, it may appear, that we are not to consider the Force of the Heart, and Contraction of the larger Arteries, as the sole Causes of the Circulation of the Fluids in Animals. The whole vascular System is endowed with a moving Power, which is constantly excited to Action by the Stimulus of the circulating Fluids; so that, while the small Vessels, by means of Frictions, destroy, in Part, the Moment of the Juices; they, at the same Time, communicate, by their gentle vibratory Contractions, a new Impulse to them. Every Part, therefore, of the vascular System, as well as the Heart and larger Arteries, nay, every Ringlet even of the smallest Vessel, is to be conceived as promoting the Circulation of the Fluids, that great Work, upon which the Life of the Whole depends; and, in carrying on which, almost every Part of the Body is active.

If the Motion of the Fluids, in the inferior Order of Vessels, be not so much owing to the Force of the Heart and larger Arteries, as to the gentle alternate Contractions of those Vessels themselves; we may easily see, why Frictions, warm, penetrating, and stimulating Fomentations, Cataplasms, &c. are often more successful than internal Medicines, in removing Obstructions in the serous, lymphatic, and other small Vessels; since they not only contribute to attenuate the obstructing Matter, but greatly increase the oscillatory Motion of these Vessels.

For the same Reason it is, that the warm mineral Waters, pumped with a considerable Force upon a Part affected with the Rheumatism, or Sciatica, have effected a Cure, after other Remedies have been used in vain,

Warm Spirit of Wine, either alone, or mixed with other Things, often proves a good Diobstruent; yet I have known some People, who were afraid to use it, with this Intention, because it is known to coagulate the Serum of the Blood: But their Fears were without Foundation. For the Quantity of Spirit of Wine which enters, by the Pores of the Skin, is so small, as to be in no Danger of producing any Coagulation. Besides, as it is taken in by the absorbent Veins, it must go to the Heart, and be mixed with the Mass of Blood, before it can come at the obstructed Vessels. But, altho' little is to be expected from the resolving, and nothing is to be dreaded from the coagulating Power of the Spirit of Wine; yet it proves, in many Cases, a good Deobstruent, by raising an uncommon vibratory Motion and Heat in the Vessels of the Part to which it is applied.

If the Circulation in the small Vessels be, in a great measure, owing to their oscillatory Motion excited by the Stimulus of the circulating Fluids; it will follow, that when these Vessels, in any Part of the Body, are affected with an extraordinary Irritation, they must necessarily be agitated with much stronger and more frequently repeated Contractions than usual; whence the Force of the Blood in them will be greatly increased: In Consequence of which, the Part will be inflated, and Globules of red Blood will be forced into the ferrous Vessels, i. e. an Inflammation will be produced; and this must happen, whether the Force of the Blood be, or be not, increased in the other Vessels of the Body.

An Inflammation, therefore, is not owing to an increased Force of the Heart and larger Arteries consequent upon an Obstruction, as some Authors, of great Fame, have imagined; but to an increased oscillatory Motion in the small Vessels; whether

whether this arises from some obstructing Matter distracting their Fibres, or acrid Matter irritating them.

An Obstruction, without an Irritation in the obstructed Part, never occasions an Inflammation; but the Irritation of any sensible Part with a sharp Instrument, or acrid Matter, never fails to produce this Effect, although there be no preceding Obstruction, nor Increase of the Heart's Force.

When a larger Artery is tied, in the Operation of the Aneurism, we do not find that the increased Moment of the Blood, in the neighbouring Arteries, produces an Inflammation in the Arm; but when a Tendon is wounded, in Blood-letting, or a little acrid Matter is collected below the Nail; a remarkable Pain, Swelling, and Inflammation of this Member, follow.

However, although an increased Force of the Blood, in the large Vessels, is not the Cause of an Inflammation; yet it is frequently the Consequence of it: For, as often as the Inflammation is large, or the Part inflamed very sensible, the whole nervous System will be so affected by the Pain, as to render the Heart and larger Arteries more irritable, at the same Time that the Blood, now irritated by the Obstruction and Inflammation, must act upon them as a stronger Stimulus than usual.

Hence we may see, why, in Inflammations, the Pulse is often little changed till the Disease has continued for some considerable Time. In Inflammations of the Stomach, Intestines, and Uterus, the Pulse, though much quickened, often continues small: Because, on account of the particular Sympathy between their Nerves and those of the Heart, this Muscle is rendered so irritable, as to contract before its Ventricles are filled with the returning venal Blood.

From what has been said, it may appear, that, in the Cure of Inflammations, besides diminishing the Force of the Circulation in general by Blood-letting, a particular Regard is to be had to the Vessels of the Part affected, whose extraordinary Contractions should be lessened by proper emollient and anodyne Applications; and, in many Cases, by blistering the neighbouring Parts.

The ingenious Dr. PRINGLE has often observed the good Effects of Blisters, when early applied, even in Pleurifies, and other internal Inflammations: And I have seen a Blister lessen, remarkably, in twelve or fourteen Hours, the Frequency of the Pulse in an Angina, after Bleeding had done no Service.

I know many Physicians have entertained Prejudices against Blistering in Inflammations, because, by their Irritation, they increase the Force of the Circulation in general: But, not to mention the good Effects they may have, by attenuating the obstructing Matter, and making a considerable Derivation, from serous Humours, from Vessels which are neatly connected, or those of the Part affected, if the Account we have given of Inflammations be true, it must follow, that, altho' the material Cause of an Inflammation, i. e. the acrid or obstructing Matter, be not immediately removed by Blistering; yet, if (according to HIPPOCRATES's Observation) the painful Sensation in the inflamed Vessels be lessened by its Means, the extraordinary oscillatory Motions of these Vessels, and, consequently, the Cause continuing and increasing, the Inflammation must be also lessened. Hence it appears, that a Blister, though it tends to increase the Force of the Circulation in general, may yet lessen the Impetus of the Blood upon the Vessels of an inflamed Part more remarkably, than Blood-letting itself.

What

What has been said of Blistering, may be applied, also, to Cupping and Scarifying, in Pleurifies, Anginas, &c.

Sinapisms, laid to the Soles of the Feet, remove and lessen Ravings; not by determining the Blood more copiously to the inferior Extremities (for their Effect, in this Respect, is altogether trifling), but by raising a very considerable Pain, which so affects the Mind, as to render it less sensible of the unusual Stimulus or Irritation in the Brain, or its Membranes; i. e. of the Cause producing and continuing the Delirium. Nor is it material to what Part of the Body those Cataplasms are applied: For a strong Delirium, in a Fever, has been removed by the Application of a Sinapism, by Mistake, instead of a Poultrice of Theriac, to the Region of the Stomach.

We may also, from what has been said, see how Ravings, Phrenzies, and Madness, have been cured by the Power of Music, or by a sudden Fright: For these, by greatly affecting the Mind, and fixing its Attention, not only render it less sensible of the disordered State of the Brain and its Membranes; but, by the strong Impressions they make on the Sensorium Commune, may tend to dislodge or remove the Cause of the Disease.





LECTURE XXIV.

Of the PULMONES, and their Appendages.

THE Pulmones, or Lungs, are two spongy Substances, of a reddish Colour in Children, greyish in Adults, and bluish in old Age, filling the whole Cavity of the Thorax; one being seated on the Right, the other on the Left; divided by the Mediastinum and Heart, and their Figure answering to that of the Cavity which contains them; that is, convex next the Ribs, concave next the Diaphragm, and irregularly flattened and depressed next the Mediastinum and Heart.

They are distinguished into the right and left Lung; and each of these into two or three Portions called Lobi, of which the right Lung has commonly three, or two and a Half, and the left Lung two. The right Lung is generally larger than the left, answerably to that Cavity of the Thorax, and to the Obliquity of the Mediastinum.

At the inferior Margin of the left Lung there is an indented Sinus opposite to the Apex of the Heart, which is therefore never covered by that Lung even in the strongest Inspirations; and, consequently, the Apex of the Heart and Pericardium may always strike against the Ribs; the Lungs not surrounding the Heart in the Manner commonly imagined.

The

The Substance of the Lungs is almost all spongy, being composed of an infinite Number of membranous Cells, and of different Sorts of Vessels spread among the Cells, in innumerable Ramifications.

This whole Mass is covered by a Membrane continued from each Pleura, which is commonly said to be double; but what is looked upon as the inner Membrane, is only an Expansion and Continuation of a cellular Substance.

The Vessels which compose Part of the Substance of the Lungs are of three or four Kinds: The Air Vessels, Blood Vessels, and Lymphatics; to which we may add the Nerves. The Air Vessels make the chief Part, and are termed Bronchia.

These Bronchia are conical Tubes, composed of an infinite Number of cartilaginous Fragments, like so many irregular Semi-circles, connected by a ligamentary elastic Membrane, and disposed in such a Manner as that the inferior easily insinuate themselves within those above them.

They are lined internally by a very fine Membrane, which continually discharges a mucilaginous Fluid; and in the Substance of the Membrane are a great Number of small Blood Vessels, and on its convex Side many longitudinal Lines which appear to be partly musculous, and partly composed of an elastic Substance of another Kind.

The Bronchia are divided, in all Directions, into an infinite Number of Ramifications, which diminish gradually in Size; and, as they become capillary, change their cartilaginous Structure into that of a Membrane. Besides these very small Extremities of this numerous Series of Ramifications, we find, that all the subordinate Trunks, from the greatest to the smallest, send out, from
all

all Sides, a vast Number of short capillary Tubuli of the same Kind.

Each of these numerous bronchial Tubes is widened at the Extremity, and thereby formed into a small membranous Cell, commonly called a Vesicle. These Cells, or Folliculi, are closely connected in Fasciculi, each small Branch producing a Fasciculus proportionable to its Extent, and the Number of its Ramifications.

These small vesicular or cellulous Fasciculi are named Lobules; and as the great Branches are divided into small Rami, so the great Lobules are divided into several small ones. The Cells, or Vesicles of each Lobule have a free Communication with each other, but the several Lobules do not communicate so readily.

The Lobules appear, distinctly, to be parted by another cellulous Substance, which surrounds each of them in Proportion to their Extent, and fills up the Interstices between them: This Substance forms, likewise, a kind of irregular membranous Cells, which are thinner, looser, and broader, than the bronchial Vesicles.

This Substance is dispersed through every Part of the Lungs, forms cellulous or spongy Vaginæ which surround the Ramifications of the Bronchia and sanguine Vessels, and is afterwards spread over the external Surface of each Lung, where it forms a kind of fine cellular Tunic, joined to the general Covering of that Viscus.

Dr. HELVETIUS first observed, that when we blow into this interlobular Substance, the Air compresses and flattens the Lobuli; and when we blow into the bronchial Vesicles, they presently swell; and if we continue to blow forcibly, the Air passes insensibly into the interlobular Substance.

All the bronchial Cells are surrounded by a very fine reticular Texture of the small Extremities of
Ar-

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Arteries and Veins which communicate every Way with each other. The greatest Part of this admirable Structure is the Discovery of the illustrious MALPIGHIUS.

The Blood Vessels of the Lungs are of two Kinds: One common, called the pulmonary Artery and Veins; the other proper, called the bronchial Arteries and Veins.

The pulmonary Artery goes out from the right Ventricle of the Heart; and its Trunk, having run almost directly superiorly as high as the Curvature of the Aorta, is divided into two lateral Branches; one going to the right Hand, called the right pulmonary Artery; the other to the left, called the left pulmonary Artery. The right Artery passes under the Curvature of the Aorta, and is, consequently, longer than the left. They both run to the Lungs, and are dispersed through their whole Substance by Ramifications nearly like those of the Bronchia, and lying in the same Directions.

The pulmonary Veins, having been distributed through the Lungs in the same Manner, go out, on each Side, by two great Branches which open laterally into the Reservoir or muscular Bag of the right Auricle.

The Ramifications of these two Kinds of Vessels in the Lungs, are surrounded every-where by the cellular Substance already mentioned, which likewise gives them a kind of Vagina; and the Rete Mirabile of MALPIGHIUS is formed by the capillary Extremities of these Vessels. It must be observed, that the Ramifications of the Arteries are more numerous, and larger, than those of the Veins, which, in all other Parts of the Body, exceed the Arteries, both in Number and Size.

Besides these capital sanguiferous Vessels, there are two others, called the bronchial Artery and Vein.

The

The Artery has become very famous of late, by the Description given of it by RUYSEN; the Vein was doubted of for some Time, but it exists as really as the Artery, and may be easily demonstrated.

These two Vessels are very small, appearing only like very fine Arteries and Veins coming from the Aorta, Vena Cava, and their Branches, in the Manner already said in the Description of the Arteries and Veins; and they seem to have no other Use but that of nourishing the Lungs.

The Varieties in the Origins of the bronchial Arteries and Veins, especially the first, are, their Communications or Anastomoses with each other, particularly the adjacent Vessels, and the immediate Anastomosis of the bronchial Artery with the common pulmonary Vein.

The bronchial Arteries come sometimes from the anterior Part of the Aorta Descendens Superior, sometimes from the first intercostal Artery, and sometimes from one of the Oesophagææ. They egress sometimes separately, towards each Lung, sometimes by a small common Trunk which afterwards divides to the right and left, near the Bifurcation of the Aspera Arteria hereafter to be described, and follow Ramifications of the Bronchia.

The left bronchial Artery comes pretty frequently from the Aorta and the Right, from the superior Intercostal on the same Side, because of the Situation of the Aorta; there is likewise another which arises from the Aorta posteriorly near

HELVETIUS has observed, that the Ramifications of the pulmonary Artery are more numerous, and larger, than those of the pulmonary Veins; which is the Reverse in the other Parts of the Body.

the superior Intercoſtal, and above the anterior Bronchialis.

The bronchial Artery gives off a ſmall Branch, to the Auricle of the Heart on the ſame Side which communicates immediately with the coronary Artery*.

Sometimes one bronchial Artery gives Origin to ſeveral ſuperior Intercoſtals; and ſometimes ſeveral bronchial Arteries ſend off, ſeparately, the ſame Number of Intercoſtals.

The bronchial Veins, as well as Arteries, were known to GALEN. Theſe Veins are ſometimes Branches of the Azygos, coming from the ſuperior Part of the Curvature. The left Vein is ſometimes a Branch of the common Trunk of the Intercoſtals of the ſame Side, and ſometimes both Veins are Branches of the Gutturalis.

The Lungs have a great many Nerves diſtributed through them by Filaments which accompany the Ramifications of the Bronchia and Blood Veſſels, and are ſpread on the Cells, Tunics, and all the membranous Parts of the Lungs: The Nervi Sympathetici Medii and Majores, commonly called the Nerves of the eighth Pair, or the Intercoſtals, form behind each Lung a particular Intertexture, called Plexus Pulmonaris, from whence nervous Filaments go out, which communicate with the Plexus Cardiacus and Stomachicus.

On the Surface of the human Lungs, between the external and cellular Tunic, we obſerve ſome-

* In the Year 1719, WINSLOW obſerved a very plain Anasto-moſis between ſome Branches of the left pulmonary Vein and of one of the Arteriæ Oeſophagææ, which came from the firſt left Intercoſtalis, together with a bronchial Artery of the ſame Side.

In that, or the following Year, he remarked likewiſe, an Anasto-moſis between the left bronchial Artery and the Vena Azygos; and in the Month of April 1721, he ſaw another between a Branch of this Artery and the Body of the juſt mentioned Vein.

what that looks like lymphatic Vessels: But we ought to take Care not to mistake, for such Vessels, a transparent reticular Substance observable on the Surface of the Lungs after blowing strongly into the Lobuli; this Appearance being entirely owing to the Air which passes through the bronchial Vesicles into the interlobular Cells, and which, by separating a certain Number of Lobuli, finds Room to lodge between them. The true lymphatic Vessels of the Lungs are most visible in Brutes; and in Horses, particularly, WINSLOW has observed one of these Vessels to run along a great Part of one Margin of the Lungs.

Under the Radix of each Lung, that is, under that Part formed by the subordinate Trunk of the pulmonary Artery, by the Trunks of the pulmonary Veins, and by the Trunk of the Bronchia, there is a pretty broad membranous Ligament which ties the posterior Margin of each Lung to the lateral Parts of the dorsal Vertebræ, from that Radix to the Diaphragm.

The Bronchia are Branches or Ramifications of a large Canal, partly cartilaginous, and partly membranous, called Trachea, or Aspera Arteria. It is situated anteriorly in the inferior Part of the Cervix, from whence it runs down into the Thorax, between the two Pleuræ, through the superior Space left between the Duplicature of the Mediastinum, behind the Thymus.

Having reached as low as the Curvature of the Aorta, it divides into two lateral Parts, one towards the right Hand, the other towards the left, which enter the Lungs, and are distributed thro' them in the Manner already said: These two Branches are called Bronchia, and that on the right Side is shorter than that on the left; whereas the right pulmonary Artery is the longest.

The Trachea is composed of Segments of Circles, or cartilaginous Hoops, disposed in such a Manner, as to form a Canal open on the posterior Part, the Cartilages not going quite round; but this Opening is filled by a soft glandular Membrane, which completes the Circumference of the Canal.

Each Circle is about the twelfth Part of an Inch in Breadth, and about a Quarter of that Space in Thickness: Their Extremities are round; and they are situated horizontally above each other, small Interstices being left between them, and the inferior Margin of the superior Segments turned superiorly to those next below them.

They are all connected by a very strong elastic membranous Ligament fixed to their Margins. WINSLOW observed the first three Segments united into one bent alternately in two different Places, according to its Breadth. Sometimes two are continuous in the same Manner.

The Canal of the Aspera Arteria is lined internally by a particular Membrane which appears to be partly muscular, and partly ligamentary, perforated by an infinite Number of small Foramina more or less imperceptible, through which a mucilaginous Fluid continually passes, to defend the internal Surface of the Trachea against the Acrimony of the Air which we breathe.

This Fluid is secreted from small glandular Bodies dispersed through the Substance of the Membrane, but especially from Glands somewhat larger than the former, which lie on the external or posterior Surface of that strong Membrane by which the Circumference of the Canal is completed. The same is observable in the Ramifications of the Trachea, from the greatest to the smallest.

All the Vessels of which the Lungs are chiefly composed, that is, the Bronchia, or Air Vessels;
and

and sanguiferous Vessels, that is, the pulmonary and bronchial Arteries and Veins, accompany each other through the whole Viscera.

They are commonly disposed in such a Manner, even to the last Ramifications, as that a subordinate Trunk or Branch of the Bronchia lies between the like Trunks or Branches of the pulmonary Arteries and Veins; the bronchial Vessels being immediately connected to the Bronchia. In some Places these three Kinds of Vessels touch each other in such a Manner, as to leave a triangular Space in the Middle.

The Bronchia are divided into a very great Number of Ramifications; and the last Rami are the Pedicles or Footstalks of the small Lobuli: All the Lobuli are angular, oblong, broad, thin, &c. The Pedicles send out other smaller ones, which are very short, and terminate in the bronchial Vesicles or Cells, of which they are Continuations. The subordinate Trunks and Rami detach a great Number of these Pedicles from their convex Surface.

When we blow into the Lungs, the bronchial Cells nearest their external Surface appear like small Portions of round Vesicles; and, from this Appearance, all the bronchial Cells have got the Name of Vesicles, though they are all angular, except those which I have now mentioned.

When we examine a Lung uninflated, we find, that the cartilaginous Segments of the Bronchia lie so near, as to be engaged in each other; and in drawing out any Portion of the Bronchia by the two Ends, these Segments are parted, and the whole Canal is increased in Length; but it contracts again, by means of its elastic Membrane, as soon as that Force is taken off.

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When we open lengthways any Portion of the pulmonary Artery and Vein in the same Lung, we meet with a great Number of transverse Rugæ, which are destroyed when these Vessels are elongated. Observed by HELVETIUS.

By Virtue of this Structure, all the Ramifications, both of the Bronchia and pulmonary Arteries and Veins, have constantly the same Direction, whether the Lung be inflated, or collapsed; and they contract, in Length, without being either contorted or folded. In Expiration these Vessels are elongated, and shortened in Inspiration.

These three Vessels lie in a sort of cellular Vagina which accompanies all their Ramifications, and is a Continuation of the interlobular Cells, or cellular Substance in the Interstices of the Lobuli. The Pelliculæ which compose it are, however, disposed there in a more regular Manner, and more longitudinally, than in other Places, and thereby appear to form a true Vagina.

When we blow through a Pipe introduced so far as to touch immediately a Trunk of the sanguiferous Vessels or Bronchia, the Air passes, at first, through all the Cells which lie nearest that Trunk, or its Branches; but, if we continue to blow, it insinuates itself through the whole interlobular Substance.

At the Angle of the first Ramification of the Trachea Arteria, we find, on both the anterior and posterior Sides, certain soft, roundish, glandular Bodies, of a blueish or blackish Colour, and a Texture partly like that of the Thymus, already described, and partly like that of the Glandula Thyroides. There are other Glands, of the same Kind, at the Origin of each Ramification of the Bronchia; but they decrease proportionably, in Number and Size: They are fixed immediately to the Bronchia, and covered by the interlobular Substance;

stance; and they seem to communicate, by small Openings, with the Cavity of the Bronchia.

The Trachea has several Tunics, as has been already observed. The external or common Covering surrounds that Part of the Trachea which lies in the Thorax; but out of the Thorax this first Tunic is derived from the aponeurotic Expansions of the Muscles of the Neck; and it is between this and the following Covering that the Glands, already mentioned, are situated.

The second is a proper Tunic, being a Continuation of the cellular Covering of the Lungs; and the Pelliculæ thereof, nearest the cartilaginous Segments, serve them for an external Perichondrium: The third Membrane lies internally, adhering closely to the same Cartilages, and supplying to these the Place of an internal Perichondrium.

The fourth Membrane is that which completes the Circumference of the cartilaginous Circles of the Trachea. It consists chiefly of two Laminæ or Strata, partly muscular, and partly tendinous; the external or posterior Lamina being formed of longitudinal Fibres, and the internal or anterior, of transverse Fibres. This Membrane is perforated by the small Ducts of the abovementioned Glands, which discharge a Fluid, when pressed; and, being examined through a Microscope, they appear vesicular or folliculous, much like those of the Stomach.

The Ligaments between the cartilaginous Circles are very strong and elastic; and each of them is confined to two Cartilages without communicating with any of the rest; being fixed to the Margins of these Cartilages much in the same Manner as the intercostal Muscles are inserted in the Ribs.

As the Bronchia penetrate into the Substance of the Lungs, they gradually lose their Cartilages;

but the muscular Lines or Columnæ of MOR-GAGNI appear as much, and sometimes more than before. The two Planes abovementioned continue likewise to be visible; and we observe very distinctly, sometimes even without a Microscope, a great many small Apertures in the Pedicles of the Lobuli, and bronchial Vesicles or Cells, which open externally.

RESPIRATION is performed by Organs of two Kinds; one of which may be looked upon as active, the other as passive. The Lungs are of the second Kind; and the first comprehends, chiefly, the Diaphragm and intercostal Muscles.

As soon as the intercostal Muscles begin to contract, the Curvatures of the Ribs are raised, together with the Sternum, and placed at a greater Distance from each other; by which means the Cavity of the Thorax is enlarged on the two lateral and anterior Sides.

At the same Instant the Diaphragm is flatted or brought towards a Plane by two Motions, which are apparently contrary; that is, by the Contraction of the Diaphragm, and the Dilatation of the Ribs, into which it is inserted. The external Surface of the Thorax being thus, in a Manner, increased, and the Cavity of the Bronchia being at the same Time, and by the same Means, less resisted or pressed upon; the ambient Air yields to the external Pressure, and insinuates itself into all the Places where the Pressure is diminished; that is, into the Aspera Arteria, and all the Ramifications of the Bronchia all the way to the Vesicles. This is what is called Inspiration.

This Motion of Inspiration is instantaneous, and ceases in a Moment by the Relaxation of the intercostal Muscles; the elastic Ligaments and Cartilages of the Ribs bringing them back, at the same Time, to their former Situation. This Motion,

tion, by which the Ribs are depressed, and brought nearer to each other, is termed Expiration.

The bronchial Arteries and Veins, thro' all their Ramifications, surround the Vesicles, transmit the Blood thro' their narrow capillary Extremities, and thereby change or modify it, at least in three different Manners.

The first Change or Modification which the Blood undergoes in the Lungs is, to have the Cohesions of its Particles extenuated: The second is, to be deprived of a certain Quantity of Serum, which transpires through the Lungs, and is what we commonly call the Breath: The third is, to be, in a Manner, reanimated by the Impression of the Air; whether the whole Body of the Air enters the Blood, whether the common Air is only the Vehicle of some finer Parts which are conveyed to it, or whether the Air only compresses and shakes the Blood, as it passes round the bronchial Vesicles in the reticular capillary Extremities of the Vessels.

The Cartilages of the Aspera Arteria and Bronchia serve, in general, to compose a Canal, the Sides of which will not sink in, or subside by, Compression; but will, nevertheless, yield to certain Pressures and Impulses, without breaking. As these Cartilages are not perfect Circles or Rings, and as their Circumferences are completed by elastic Membranes, they allow of those Dilatations and Contractions which modulate the Voice; and as they are connected by elastic Ligaments of a considerable Breadth, the alternate Elongation and Contraction of the Bronchia is facilitated in the Motions of Respiration.

I shall be more particular, concerning Inspiration and Expiration, in my next Lecture, on that Subject.

THE LARYNX

Forms the Protuberance in the superior and anterior Part of the Neck, commonly called Pomum Adami. Anatomists term it the Head of the Trachea Arteria; and it is larger, and more prominent, in Men, than in Women.

It is chiefly formed of five Cartilages, the Names of which are these: Cartilago Thyroïdes, which is the anterior, and largest; Cricoïdes, the inferior, and Basis of the rest; two Arytenoïdes, the posterior and smallest; and the Epiglottis, which is above all the rest. These Cartilages are connected by Ligaments; and they have, likewise, Muscles, Glands, Membranes, &c. belonging to them.

The Cartilago Thyroïdæa is large and broad, and folded in such a Manner, as to have a longitudinal Convexity on the anterior Side, and two lateral Portions which may be termed Alæ. The superior Part of its anterior middle Portion is formed into an angular Fissure; the superior Margin of each Ala makes a Curvature, and, together with the middle Fissure, these two Margins resemble the superior Part of an Ace of Hearts in playing Cards.

The inferior Margin of each Ala is more even, and the posterior Margins of both are very smooth, being lengthened out, both above and below, by Apophyses, which I name the Cornua of the thyroïd Cartilage. The superior Apophyses are longer than the inferior, and the Extremities of all the four are rounded like small Heads, which, in the inferior Apophyses, have a shining Surface on the internal Side, resembling an articular Eminence.

Externally on each Ala, near the Margin, is a prominent oblique Line which runs from behind forwards. The superior Extremity of this Line is
near

near the superior Apophysis or Cornu, and both that and the inferior Extremity end in a small Tuberosity, the lowest being often the most considerable. These Tuberosities serve for the Insertion of Muscles and Ligaments. The internal Side of the Alæ, and the convex Side of the anterior Portion, are very uniform; and this Cartilage ossifies gradually in old Age.

The cricoid Cartilage resembles a kind of thick, irregular Ring, very broad on one Side, and narrow on the other; or it may be compared to a small Portion of a thick Tube, cut horizontally at one End, and very obliquely at the other. I distinguish it into a Basis and Apex, into an anterior, posterior, and two lateral Sides. The Basis is almost horizontal when we stand, and so this the Aspera Arteria is connected, so that the Cricoïdes may be looked upon as the superior Extremity of the Trachea.

The posterior Portion of the Cricoïdes is larger than the rest, and its posterior or convex Side is divided by a longitudinal Eminence, or prominent Line, into two distinct Surfaces, for the Insertion of Muscles: The Apex is gently sloped above this prominent Line, and terminates, on each Side, by a kind of obtuse Angle, formed between it and the oblique Margin of each lateral Portion of this Cartilage. At the superior Part of each of these Angles, there is a very smooth articular Surface, gradually convex.

The whole posterior Side is distinguished into two lateral Portions by two prominent Lines, each of which runs down, almost in a strait Direction, from the articular Surface at the Apex, a little below the Middle of this Side, where it terminates in another articular Line a little concave; and near these four articular Surfaces there are small Tubercles. The two superior Surfaces are for the Articulation

culatation of the Cartilagines Arytenoïdææ, and the two inferior for the Articulation of the inferior Cornua or Appendices of the Cartilago Thyroïdes.

The Cartilagines Arytenoïdææ are two small, equal, similar Cartilages, which, connected, resemble the Spout of an Ewer; and they are situated on the Top of the Cricoïdes. In each, we may consider the Basis, Cornu, two Sides, one posterior and concave, the other anterior and convex; and two Margins, one internal, the other external, which is very oblique: The Bases are broad and thick, and have each a concave articular Surface, by which they are joined to the Cricoïdes.

The Cornua are bent posteriorly, and a little towards each other: In some Subjects they are very loose, appearing like true Appendices, and easily separable from the rest; between their internal Margins they form a kind of Fissure, and their external oblique Margins terminate each by a thick prominent Angle.

The Epiglottis is an elastic Cartilage, nearly of the Figure of a Purshane Leaf, narrow and thick inferiorly, thin and slightly rounded superiorly, gradually convex anteriorly, and concave posteriorly. It is situated above the anterior or convex Portion of the Cartilago Thyroïdes, and its inferior Extremity is tied by a short, pretty broad, and very strong Ligament, to the Middle Fissure in the superior Margin of that Cartilage. It is perforated by a great Number of Apertures, somewhat like those in the Leaves of the Hypericum, or St. John's Wort, which are hid by the Membranes that cover its two Sides.

The Cartilago Thyroïdes is connected to the Cricoïdes by several short strong Ligaments, round the Articulations of the two inferior Cornua with
the

the lateral articular Surfaces of the Cricoïdes; the Apices of the superior Cornua are fixed to the posterior Extremities of the great Cornua of the Os Hyoïdes, by slender round Ligaments, about a Quarter of an Inch in Length.

In the Middle of each of these Ligaments we often meet with a small Cartilage of an oval Figure, and much thicker than the Ligaments: The Thyroïdes is likewise connected to the Os Hyoïdes by a short, broad, strong Ligament, one End of which is inserted into the superior Fissure of the Cartilage, and the other in the inferior Margin of the Basis of the Bone: It has also two Ligaments at the Middle of the concave Side, which belong to the Arytenoïdææ.

The Cricoïdes is tied inferiorly to the Thyroïdes by a strong Ligament; and, by the Ligaments already mentioned, to the inferior Cornua of that Cartilage: Its Basis is fixed to the first cartilaginous Ring of the Trachea Arteria by a Ligament exactly like those by which the other Rings are connected together; and the membranous or posterior Portion of the Trachea is likewise fixed to the posterior Part of the Basis of the Cricoïdes.

The Cartilagines Arytenoïdææ are connected to the Cricoïdes by Ligaments, which surround their Articulations with the Apex of that Cartilage: Anteriorly the Basis of each Arytenoïdes is fixed to one End of a ligamentary Cord, which, by its other End, is inserted about the Middle of the concave Side of the anterior Portion of the Thyroïdes: At their Insertions in the Thyroïdes, these two Ligaments touch each other, but a small Space is left between them, where they are fixed in the two Arytenoïdes; and they seem, likewise, to have a small Adhesion to the Apex of the Cricoïdes. This is what is called the Glottis.

Under these two ligamentary Cords there are two others which run likewise from behind forwards: The Interstice between the superior and inferior Cords on each Side form a transverse Fissure, which is the Opening of a small membranous Capsula, the Basis of which is turned externally, that is, towards the Ala of the Thyroides: These two Sacculi are the Ventracles mentioned by the Antients, and restored by MORGAGNI, who has given an excellent Description of them. They are chiefly formed by a Continuation of the internal Membrane of the Larynx, and the internal Surface of their Basis sometimes appears to be glandulous.

On the anterior Surface of the arytenoïd Cartilages, there is a small Depression between the Basis and convex superior Part: This Depression is filled by a glandulous Substance, which not only covers the anterior Surface of each Arytenoïdes, but is likewise extended anteriorly from the Basis over the posterior Extremity of the adjacent ligamentary Cord: They are larger and more sensible in some Subjects, than in others; and are covered by the Membrane that lines the adjacent Parts. These Glands were discovered by MORGAGNI.

We have already described the Ligaments that connect the Epiglottis to the Fissure of the Thyroides, and to the Basis of the Os Hyoides: These two Ligaments, and a third, which ties the Basis of the Os Hyoides to the Fissure of the Thyroides, form a triangular Space filled with a cellular or fatty Substance, and with small Glands.

The Epiglottis has likewise two lateral Ligaments, by which it is connected to the Arytenoïdes, all the way to their Points, or Cornua: It has also a membranous Ligament, which, running along the Middle of its anterior or concave Side, ties it to the Root or Basis of the Tongue: This Li-

gament is only a Duplicature of the Membrane that covers the Epiglottis continued to the adjacent Parts. Lastly, There are two lateral membranous Ligaments belonging to it, fixed near the glandulous Bodies, called Amygdalæ.

The Epiglottis is not only perforated by the regular Foramina already mentioned, but has likewise a great Number of small irregular Scissures and Breaks, which are so many different Lacunæ situated between its two Membranes, and filled with small Glands, the excretory Orifices of which are chiefly on the posterior Side of this Cartilage.

The Larynx gives Insertion to a great Number of Muscles, which may be divided into common, proper, and collateral*. The common Muscles, according to the general Acceptation of that Term, are all those that move the whole Body of the Larynx, one Extremity of them being inserted in other Parts; and these are reckoned to be four in Number, two for each Side; viz. Sterno Thyroïdæi, and Thyro Hyoïdæi, or Hyo Thyroïdæi.

The proper Muscles are those inserted wholly in the Larynx, and which move the Cartilages separately: These have been divided various Ways but may be all reduced to eight Pairs.

The Sterno Thyroïdæi are two long, flat, narrow, thin Muscles, like Ribbons, broader above than below, and situated along that Part of the

* By the collateral Muscles, I understand those which are inserted by one Portion in the Larynx, without appearing to contribute any Thing to the Motions of it. Of this Kind are, the Thyro Pharyngæi, Crico Pharyngæi, &c.

The Larynx may likewise be moved by Muscles which are not immediately inserted into it, but altogether in other Parts. Such are the Mylo Hyoïdæi, Genio Hyoïdæi, Stylo Hyoïdæi, Omo Hyoïdæi, Sterno Hyoïdæi, and especially the Digastrici of the inferior Maxilla; by reason of their particular Adhesion to the Os Hyoides. It is likewise probable, that those Muscles of the Pharynx which are inserted in the Basis Cranii, may, in certain Circumstances, move the Larynx, in some small Degree.

Cervix which lies between the thyroïd Cartilage and the Sternum. They are covered by the Sterno Hyoïdæi, and they cover the thyroïd Glands, passing immediately before them.

Each Muscle is fixed, by its inferior Extremity, partly in the superior Portion of the internal or posterior Side of the Sternum, partly in the Ligament and circumjacent Portion of the Clavicula, and partly in the cartilaginous Portion of the first Rib. Sometimes it runs a great way down on the first Bone of the Sternum, and crosses the Muscle on the other Side; from thence it ascends on the Aspera Arteria, close by its Fellow, passes before the thyroïd Glands over the cricoïd Cartilage, and is inserted, by its superior Extremity, into the inferior Part of the lateral Side of the thyroïd Cartilage, and partly along that whole Side*.

The Thyro Hyoïdæi, or Hyo Thyroïdæi, are two flat thin Muscles, lying close by each other, between and above the former: Each of them is inserted, by its superior Extremity, partly into the Basis, and partly into the adjacent Part of the great Cornu of the Os Hyoïdes; and, by its inferior Extremity, into the inferior Part of the lateral Side of the thyroïd Cartilage, immediately above the superior Extremity of the Sterno Thyroïdæus; and both this superior Extremity of the last named Muscle, and the inferior Extremity of the Thyro Hyoïdæus, are, at their Place of Union, confounded a little with the Thyro Pharyngæus Inferior.

The Crico Thyroïdæi are two small Muscles, situated obliquely at the inferior Part of the thyroïd Cartilage: They are inserted, by their inferior Extremities, into the anterior Portion of the

* WINSLOW has found this Muscle double; one distinct Portion of it being inserted into the Basis, and the other laterally.

cricoid Cartilage, near each other; and, by their superior Extremities, laterally into the inferior Margin of the thyroïd Cartilage, at a Distance from each other. By this oblique Situation, they represent a Roman V.

Each of these small Muscles is, in a Manner, double, its superior Extremity, inserted into the thyroïd Cartilage, being, in some Subjects, very broad, and divided into two Portions, one anterior, the other more lateral, and more oblique: They may likewise be easily separated into two distinct Muscles; whereof one may be called Crico Thyroïdæus Anterior or Internus; the other Lateralis or Externus.

The two Musculi Crico Arytenoidæi Posteriores are situated posteriorly at the large or back Portion of the Cricoïdes, filling almost the two longitudinal Surfaces of that Portion, and distinguished by the prominent Line between these two Surfaces, already mentioned. Each of them runs up obliquely, and is inserted, by its superior Extremity, into the posterior Part of the Basis of the arytenoid Cartilage of the same Side, near the Angle of that Basis.

The two Crico Arytenoidæi Laterales are small, and situated more laterally than the former. Each Muscle is fixed, by one End, to the Side of the broad Part of the Cricoïdes; and, by the other, to the inferior Part of the Side of the adjacent Arytenoides.

The two Thyro Arytenoidæi are very broad, each Muscle being situated laterally between the Thyroïdes and Cricoïdes. It is fixed, by a broad Insertion, to the internal Side of the Ala of the thyroïd Cartilage; and the Fibres, contracting from thence, run from before backward, and from below towards the adjacent arytenoid Cartilage, in which they are inserted, from the Glottis to the

Angle of the Basis. In some Subjects, these Muscles cover almost both Sides of the Glottis.

The Arytenoïdæi are small Muscles lying on the posterior concave Sides of the arytenoïd Cartilages*.

The crucial Muscles run each obliquely from the Basis of one arytenoïd Cartilage to the middle and superior Part of the other; the left Muscle covering the right, as is observed by MORGAGNI, in his first Adversaria.

I look upon these Muscles as superior Crico Arytenoïdæi, because I have always found them partly inserted into the superior circumjacent Portion of the Cricoïdes. The Arytenoïdæus Transversalis is inserted more or less directly by both Extremities, in the two arytenoïd Cartilages; and this I look upon as the true Musculus Arytenoïdæus. WINSLOW.

The two Thyro Epiglottis cross the Thyro Arytenoïdæi, being inserted into the internal lateral Part of the Thyroïdes, and laterally into the Epiglottis.

The Aryteno Epiglottici are small musculous Fasciculi, each of which is fixed, by one Extremity, in the Head of one of the arytenoïd Cartilages; and, by the other, in the nearest Margin of the Epiglottis.

I never had an Opportunity of examining the Hyo Epiglottici in very muscular Subjects; and therefore I am not sure that the Fibres which go from the convex Side of the Basis of the Os Hyo-

* Dr. JAMES DOUGLAS, in the first Edition of his Treatise of the Muscles, divided them into two Kinds; one of which he called Arytenoïdæi Majores, the other Arytenoïdæi Minores: And it must be owned, that there is some Variety, in different Subjects. I shall here confine myself to what I have most frequently and most distinctly observed; and that is, that there are two crucial Arytenoïdæi, and one transverse. WINSLOW.

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ides to the convex Side of the Epiglottis, are really musculous. WINSLOW.

The Larynx serves, particularly, to admit and let out the Matter of Respiration; and the Solidity of the Pieces, which it is composed of, hinders not only external Objects, but also any hard Thing, that we swallow, from disordering this Passage. The Glottis, being a narrow Slit, modifies the Air that we breathe; and, as it is very easily dilated and contracted, it forms the different Tones of the Voice, chiefly, by means of the different Muscles inserted into the Cartilagines Arytenoïdææ, to which the other Muscles of the Larynx, both proper and common, are Assistants.

The whole Larynx is likewise of Use in Deglutition, as shall be explained, by means of its Connexion with the Os Hyoides, to which the digastric Muscles of the inferior Maxilla adhere; which Muscles raise the Larynx, together with the Os Hyoides, every Time we swallow; as shall be explained, after the Description of the Pharynx and Tongue.

The Facility of varying and changing the Tone of the Voice, depends on the Flexibility of the Cartilages of the Larynx, and decreases, in Proportion as we advance in Age; because these Cartilages gradually harden and ossify, though not equally so soon in all Persons: And this Change happens not only to the Cartilago Thyroïdes, but also to the Cricoïdes and Arytenoïdes.

The Musculi Sterno Thyroïdæi serve, in general, to pull down the thyroïd Cartilage, and the whole Larynx with it: They may likewise assist the Sterno Hyoïdæi in its Actions, and compress the thyroïd Gland. The Thyro Hyoïdæi may, occasionally, either draw up the Larynx towards the Os Hyoides, or draw that Bone inferiorly towards the Cartilago Thyroïdes.

It is difficult to determine the Use of the Crico Thyroïdæi, from their Situation. They may either pull the Cricoïdes obliquely backwards, or the Thyroïdes obliquely forwards; and, by this Action, the inferior Cornua of the Thyroïdes, and small articular Surfaces of the Cricoïdes, must slide upon each other.

Both the lateral and posterior Crico Arytenoïdæi may separate the arytenoïd Cartilages, and thereby open or dilate the Glottis: But they do not both perform this Action in the same Manner. The lateral Muscles separate these Cartilages obliquely forwards, and, at the same Time, loosen or relax the Sides of the Glottis; but the posterior Muscles separate them obliquely backwards, and, at the same Time, stretch or extend the Sides of the Glottis; and, when both Muscles act equally, they separate the Cartilages directly.

The Thyro Arytenoïdæi, acting together, draw both the arytenoïd Cartilages forward, and, consequently, loosen the Glottis, and render it capable of the smallest Quaverings of the Voice: They may likewise, probably, compress the lateral Sinuses or Ventracles of the Larynx, and also the arytenoïd Glands.

The Arytenoïdæi bring the arytenoïd Cartilages close together, and press them against each other; and, when the Cartilages are in this Situation, they may, at the same Time, be inclined either forwards by the Thyro Arytenoïdæi, or backwards by the Crico Arytenoïdæi Posteriores: By this means, the Glottis, when shut, may be either relaxed, or tense; and, in this last Case, it is entirely shut, as when we hold our Breath in straining: But of this more in another Place.

The general Use of the Epiglottis is, to cover the Glottis like a Penthouse, and thereby hinder any Thing from falling into it when we eat or
 drink

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drink : And, for this Purpose, it is depressed in a Manner as shall be demonstrated. It serves, likewise, to hinder the Air, which we inspire, from rushing directly upon the Glottis ; but by splitting it, as it were, obliges it to enter by the Sides, or in an oblique Course. The Muscles of the Epiglottis do not appear to be absolutely necessary for that Cartilage ; for, in Deglutition, it may be sufficiently depressed by the Basis of the Tongue ; and it may raise itself again by its own Elasticity. The Thyro Epiglottici and Aryteno Epiglottici may serve to shut any lateral Openings that might remain when the Epiglottis is depressed by the Basis of the Tongue ; and the Hyo Epiglottici may pull it a little forwards in strong Respirations ; as Sighing, Mastication, &c.

Singing is caused when the Air, modulated through various Degrees of Acuteness and Gravity, is expelled through the Larynx, while it is trembling and suspended between two contrary Powers : And herein lies the principal Difference between the chanting of simple Notes, and the Expression of Words. Hence it appears to be a laborious Action, by reason of the continual Contractions of the Muscles, which keep the Larynx in equilibrio ; and hence it is, that Singing makes a Person hot ; because, in acute Tones, the narrower Glottis much retards the Expiration ; while, at the same Time, a great deal of Air is required to give Strength to the Voice, towards which, again, deep Inspirations are necessary. Hence, likewise, the Wind-pipe is rendered very dry, from the quicker Passage or Current of Air, to prevent which, a great deal of Music is required ; and therefore it is, that there are such Numbers of mucous Receptacles in the Larynx ; among which, Dr. HALLER is of Opinion, the Vesicles, before described, ought to be numbered.

Speech is performed by the Larynx at Rest, or held in the same Place, in Tones of Voice differing but little in Acuteness and Gravity; but then the Voice is variously changed, or modulated, by the Organs of the Mouth. Canorous Speech has a Variation in the Tone or Cadence of the Voice, together with a Modulation of it by the Organs of the Mouth at the same Time.

All Speech is reducible to the Pronunciation of Letters, which differ in various Nations, but most of them are alike all the World over. Of these, some are called Vowels, which are made only by an Expression of the Voice through the Mouth, without any Application of the Tongue to certain Parts of the Mouth; but Consonants are formed by a Collision of the Tongue against certain Parts of the Mouth, Lips, and Teeth: But, to be more particular in these Matters, is beside our Purpose, which will not permit us to expatiate on the beautiful Art of Pronunciation.

That Art, as an extraordinary Instance of mechanical Knowledge, has so accurately determined all the corporeal Causes, concurring to each Letter, that, by Inspection only, with the Assistance of Touch, Letters pronounced are understood without hearing them, and the attentive Person is thereby taught to imitate the same Speech by a like Use of the Organs.

Whether or no all the Difference of Tone in the Voice depends entirely upon the Length of the Ligaments of the Glottis, increased by the scutiform Cartilage drawn forwards, and the arytenoid Cartilage drawn backwards, in such a Manner, that the sharpest are those made by the Ligaments in the greatest Tension; and, therefore, with a quicker Vibration? This had been advanced by the Experiments of some Gentlemen of Note, and since repeated by other Anatomists (who judge that

That the tense Cords or Ligaments of the Glottis do, from the Air perflated by the Wind-pipe, produce the Voice, and its feveral Tones, in Animals; fo that greater Tenfity and Clofure of the Ligaments yields a more acute Voice, as a Laxity of them occasions a more grave Tone of the Voice. That thofe Ligaments, drawn clofe, fuppreff the Voice; or, being half way fhut, and the reft open, they give a Tone that is an Octave higher; as a third Part of them, thus fhut, yields a Fifth higher, &c.) I fhall not take upon me to determine, in a Matter of fuch Importance, that has not yet fallen under my Examination experimentally; there are confiderable Doubts, or Objections, to be made againft this System, taken from the cartilaginous and offeous Glottis, which is thus immoveable, and in no ways extenfible in Birds; alfo from the Voice becoming infallibly more acute in Whiffling, merely by a Contraction of the Lips only; as alfo from the Instance of Women, who, having a fhorter Larynx and Glottis than Men, nevertheless utter a more fhriU Voice: Likewise from the Experiments, by which it appears, that the Tone becomes more acute by approximating the Ligaments of the Glottis nearer together: Again, from the Doubtfulnefs of the Credit upon which thofe new Experiments are publifhed, from the Want of a Machine, of any Perfection, to draw the fcutiform Cartilage forwards; and, laftly, from a ftrong and evident Suspicion, that the Author of the Experiment imagined the fcutiform Cartilage to be drawn forwards, when it was, in Faft, only elevated; therefore this Invention merits farther Enquiry. And as the Author's laudable Endeavours are not to be here difcouraged by a Refutation; fo neither are they to be haftily embraced with too much Credulity.

The Strength of the Voice is proportionable to the Quantity of Air blown through the Glottis; and therefore a large Pair of Lungs, easily dilatable with an ample Larynx and Trachea Arteria, joined with a powerful Expiration, all conduce to this Effect; but acute and grave Tones of the Voice we observe to arise from various Causes: The former proceeds from a Tension and Narrowness of the Glottis; and the latter from a Relaxation and Expansion of it. For thus, in the former, a greater Number of Air Waves are split, in the same Time, upon the Ligaments of the Glottis; whence the Tremors, excited at the same Time, are more numerous: But when the Glottis is dilated, the contrary of all this follows. Therefore, to produce an acute and shrill Voice, the Larynx is drawn up more powerfully, as the Voice is required to be sharper; insomuch, that an Inclination of the Head forwards is called in to assist; by which the Powers of the Muscles, elevating the Larynx, are rendered more full and effectual.

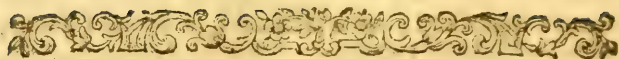
The Truth of this is confirmed by applying the Fingers to the Larynx when it forms an acute Sound: For then, to raise the Voice an Octave, you will easily perceive it to ascend near Half an Inch. The same is also evident from comparative Anatomy, which demonstrates the narrowest Glottis, and the closest Approximation of Cartilages, in carnivorous Birds; but an ample or broad Glottis in hoarse Animals, and such as bellow or bleat.

An Instance of this we have in Whistling; where the Sound manifestly becomes more acute by a Contraction, or Narrowness, at the Mouth: And also in Wind musical Instruments; in which a Narrowness of the Mouth, or Opening that expels the Air, with a Celerity of the Wind blown out, are the Causes of an acute or shrill Tone.

Gravity

Gravity of the Voice, on the contrary, follows from a Depression of the Larynx by the Causes already described; to which add, a broad Glottis, and very ample Larynx. This is evident to the Touch of a Finger applied to the Larynx, when a Person sings; by which the Descent of it is manifestly perceived to be about Half an Inch for every Octave. Hence the Voices of Males are more grave; and the lowest Degrees of the Voice degenerate into a Muteness, or Whispering. HAL-
LER. Prim. Lin. Physiolog.





LECTURE XXV.

Of RESPIRATION and EXPIRATION;
first, the Description of the Mus-
cles employed in these Offices*.

THE DIAPHRAGM is a very broad and thin Muscle, situated at the Basis of the Thorax, and serving as a transverse Partition to separate that Cavity from the Abdomen. For this Reason, the Greeks termed it Diaphragma; and the Latins, Septum Transversum. It forms an oblique inclined Arch, the anterior Part of which is highest, and the posterior lowest; making a very acute Angle with the Back.

It is looked upon as a double and digastric Muscle, composed of two different Portions: One large and superior, called the great Muscle of the Diaphragma; the other small and inferior, appearing like an Appendix to the other, called the small or inferior Muscle of the Diaphragma.

The great or principal Muscle is fleshy in its Circumference, and tendinous and aponeurotic in the Middle; which, for that Reason, is com-

* WINSLOW has reduced these Muscles to eight only, which is a smaller Number than were before.

monly called *Centrum Nervum* or *Tendinosum*. It must not, however, be imagined, that this middle Part is of small Extent, or that it is round, because Anatomists have named it the Center; for, in so doing, they had Regard only to its Situation, not to its Form, or the Space it occupies. It is of a considerable Breadth, and represents, in some measure, a Trefoil Leaf; supposing the Part to which the Footstalk is fixed to be sloped, and that this Slope is turned posteriorly, and the middle convex Part anteriorly. WINSLOW chose to call it, simply, the middle Aponeurosis, or aponeurotic Plane of the Diaphragm.

The musculous Circumference is radiated, to the Fibres of which it is composed, being fixed, by one Extremity, to the Margin of the middle Aponeurosis; and, by the other, to all the Basis of the Cavity of the Thorax; being inserted, by Digitations, into the inferior Parts of the Appendix of the Sternum, of the lowest true Ribs, of all the false ones, and in the circumjacent *Vertebræ*.

We have, therefore, three Kinds of Insertions; one sternal, twelve costal, six on each Side, and two vertebral, one on each Side.

These last are very small, and sometimes scarcely perceptible. The costal Insertions join those of the *Transversalis Abdominis*, but do not mix with them, as they seem to do, before the Membrane, which covers them, is removed. I need not mention here some communicating Fibres of the same Nature with those found in other Muscles; for Instance, between the *Obliquus Externus* and *Pectoralis Major*.

The Fibres inserted into the Appendix *Eniformis* run from behind anteriorly, and form a small parallel Plane. I have sometimes observed a *Fasciculus* of Fibres detached from the inferior Side of this Plane, to descend on the internal

ternal Side of the Linea Alba, into which it is inserted, near the Umbilicus.

The first costal Insertion runs a little obliquely towards the Cartilage of the seventh true Rib, a triangular Space being left between this and the sternal Insertion, at which the Pleura and Peritonæum meet. The Insertion of these Fibres is very broad, taking up about two Thirds of the Cartilage of the seventh Rib and a small Part of the Bone, from whence it reaches beyond the Angle of the Cartilage.

The second Insertion is into the whole Cartilage of the first false Rib, the third partly in the Bone and partly in the Cartilage of the second false Rib, the fourth in the Bone, and sometimes a little in the Cartilage of the third false Rib; the fifth in the Bone and a little in the Cartilage of the fourth false Rib, being broader than the rest.

The sixth is in the Cartilage of the last false Rib, and almost through the whole Length of the Bone. At the Head of this Rib it joins the vertebral Insertion which runs from the lateral Part of the last dorsal Vertebra to the first lumbar. Between this vertebral Insertion and the second Muscle of the Diaphragm a small triangular Interstice is sometimes left, like that which was mentioned in speaking of the first Insertion: These Insertions, and that in the last false Rib, join the superior Extremities of the Psoas and Triangularis, or Quadratus Lumborum, and sends off to them some communicating Fibres. The common Plane of these last Insertions, by the Separation of the third Fibres, form a Foramen through which a Fasciculus of Nerves passes.

It is to be observed, that the lateral Insertions of the great Muscle of the Diaphragm, on the right Side, appear to be lower than those on the left Side; and that the right lateral Portion appears

pears to be larger than the left, as being more arched.

This small Muscle of the Diaphragm is thicker than the other, but of much less Extent: It is situated along the anterior Side of the Bodies of the last Vertebra of the Back and several of those of the Lumbar, being turned a little to the Left. It is of an oblong Form, representing, in some measure, a musculous Collar, the two lateral Portions of which cross each other, and afterwards become tendinous towards the inferior Part: The superior Part of the Body of this Muscle is fixed in the Slope of the middle Aponeurosis of the great Muscle. The external Margins of the Alæ, or lateral Portions, join the posterior Plane of the great Muscle, and these Portions adhere to the Body of the last dorsal Vertebra. The Extremities, called likewise Crura, or Pillars, are inserted, by several tendinous Digitations, into the lumbar Vertebra.

The superior Part of the musculous Body is formed by a particular Intertexture of Fibres belonging to the Alæ: These two Alæ, whereof that towards the right Side is generally the most considerable, separate from each other, and form a Foramen Ovale terminated on the inferior Part by Fibres detached from the internal Side of each Ala, immediately above the last dorsal Vertebra: These Fibres decussate and cross each other, and afterwards those which come from each Ala join that on the other Side, so that each of the Crura is a Production of both Alæ.

The Fibres which come from the left Ala, cross over those from the right Ala, and this, again, sends a small Fasciculus of Fibres over those of the left Ala; afterwards the two Crura part from each other.

The right Crus is larger and longer than the left, and is always inserted into the four superior lumbal Vertebrae, and often in the fifth likewise, by the same Number of Digitations, which become more and more tendinous as they descend, and, at length, are expanded in Form of an Aponeurosis. This Crus lies more on the Middle of the Bodies of the Vertebrae than on the right Side.

The left Crus is smaller and shorter, and lies more on the Sides of the Vertebrae: It is fixed, by Digitations, to the three superior Vertebrae of the Loins, seldom reaching lower; the inferior Part of it is expanded in the same Manner as the other, and the two Expansions sometimes meet together.

The oval Aperture of this inferior Muscle of the Diaphragm gives Passage to the Extremity of the Oesophagus, and the Aorta lies in the Interstice between the two Crura: Immediately above the Aperture a thin Fasciculus of Fibres is sent off to the Stomach; and sometimes is observed a larger Fasciculus at the inferior Extremity of the Aperture, sent off chiefly from the right Ala, and accompanied by some tendinous Fibres from the left, which seemed to run to the Mesentery. In the middle Aponeurosis of the great Muscle, a little to the Right of the anterior Part of the Slope, near the small Muscle, is a round Aperture, which transmits the Trunk of the Vena Cava; the Border or Circumference of this Aperture is very artfully formed by an oblique and successive Intertexture of tendinous Fibres, almost like the Margin of a wicker Basket; and is, consequently, incapable either of Dilatation or Contraction, by the Action of the Diaphragm.

We find, therefore, three considerable Apertures in the Diaphragm: One round and tendinous, for the Passage of the Vena Cava; one
oval

oval and musculous, for the Extremity of the Oesophagus; and one forked, partly musculous, and partly tendinous, for the Aorta. The round Aperture is to the right Side, superiorly close to the right Ala of the small Muscle; the oval Aperture is a little to the Left, so that the right Ala, which is between these two Foramina, lies almost directly opposite to the Middle of the Body of the eleventh dorsal Vertebra; the tendinous Fork is under the oval Aperture, but a little more towards the Middle.

This Situation, well considered, will serve to justify, in some measure, the Descriptions and Figures of the antient Anatomists; especially since the right Ala of the small Muscle is larger than the left; and since it was an easy Matter, in taking out the Diaphragm, and spreading it on a Board, to extend it too much towards both Sides.

The SCALENI are compound Muscles, irregularly triangular; and from this Figure the antient Greeks gave them their Name. They reckoned them to be only two in Number, situated laterally on the Vertebrae of the Neck, all the Way down to the first and second true Ribs; afterwards they were divided into six, three lying on each Side; but I have commonly found no more than two on each Side, one lying upon the other; the first of which I name SCALENUS PRIMUS, or PRIMÆ COSTÆ; the other SCALENUS SECUNDUS, or SECUNDÆ COSTÆ.

The SCALENUS PRIMUS is fixed to the superior Part of the external Side of the first Rib by two distinct Portions, commonly called Branches, one anterior, the other posterior: The anterior Branch is fixed to the middle Portion of the Rib, about an Inch from the Cartilage; from thence it runs superiorly oblique, and is inserted into the trans-

verse Apophyses of the sixth, fifth, and sometimes third cervical Vertebrae.

The posterior Branch is fixed more posteriorly in the first Rib, an Interstice, of about an Inch, being left between it and the other Branch, thro' which the axillary Artery and brachial Nerves are transmitted; from thence it runs superiorly oblique behind the former, and is inserted into all the transverse cervical Apophyses.

The SCALENUS SECUNDUS is fixed a little more posteriorly in the external Labium of the superior Margin of the second Rib, sometimes by two separate Portions, and sometimes without any Division; the anterior Portion is fixed immediately under the posterior Portion of the first Scalenus, by a short flat Tendon, united a little with the first intercostal Muscle; from thence it runs superiorly over the posterior Portion of the first Scalenus, communicating, likewise, with that Muscle, and is fixed, by Insertions partly tendinous and partly musculous, in the transverse Apophyses of the four first cervical Vertebrae.

The posterior Portion is fixed in the second Rib, more posteriorly than the other; from thence it runs superiorly, being divided into two Portions, whereof one is inserted into the transverse Apophyses of the three first cervical Vertebrae, behind the Scalenus Primus; the other Portion runs superiorly behind the former, and is inserted into the transverse Apophyses of the two first Vertebrae.

The vertebral Insertions of both Scaleni vary, being sometimes confounded with each other, and sometimes with those of the adjacent Muscles; behind the Scalenus Secundus there is a small musculous Plane inserted into the transverse Apophysis of the last cervical Vertebra, and into the
second

second Rib : This does not belong to the Scaleni, but is the first of the Musculi Supra Costales, or Levatores Costarum, as they are commonly called.

In dissecting the anterior Portion of the second Scalenus, I have observed a small Muscle, fixed to the Extremity of the transverse Apophysis of the last cervical Vertebra; which, having run down from thence to the internal and inferior Part of the first true Rib, was slightly inserted there, and seemed to continue its Course to the convex Side of the Pleura. I have likewise seen all the Scaleni inserted into the first Rib.

The SERRATUS POSTICUS SUPERIOR is a flat thin Muscle, situated in the superior Part of the Back : It is fixed on one Side, by a broad Aponeurosis, to the inferior Part of the posterior cervical Ligament, and to the spinal Apophyses of the two last cervical Vertebrae, and the two first of the Back.

From thence it runs down a little obliquely forwards, and is inserted, by broad musculous Digitations, into the posterior Part of the second, third, fourth, and sometimes fifth true Ribs, near their Angles; but sometimes it has no Insertion into the second Rib. It is covered by, and closely united with, the Rhomboïdes.

The SERRATUS POSTICUS INFERIOR is a flat thin Muscle lying on the inferior Part of the Back. It is fixed in the last spinal Apophysis of the Back, and in the three first of the Loins, by a broad Aponeurosis; from thence it runs superiorly a little obliquely, and is fixed, by musculous broad Digitations, in the last four false Ribs : Its Insertion into the lowest Rib is near the Cartilage, and in the other three near their Angles. It is covered by the Latissimus Dorsi, to which it adheres very

closely, and covers the Sacro Lumbaris and Longissimus Dorfi.

The INTERCOSTAL MUSCLES are thin fleshy Planes, lying in the Interstices between the Ribs, their Fibres running obliquely from one Rib to another: In each Interstice lie two Planes, an external and an internal, closely joined together, nothing but a thin, fine, cellular, membranous Web coming between them.

According to this natural Division, there must be forty-four intercostal Muscles in the twenty-two Interstices left between the twenty-four Ribs; and of these there are eleven external, and eleven internal, on each Side: The Fibres of the external Intercostals run down from behind forwards, and those of the internal Intercostals from before backwards, so that the Fibres of these two Series of Muscles cross each other.

The external Intercostals extend commonly from the Vertebrae to the Extremity of the superior Labium of the bony Portion of each Rib, and go no farther; the internal begin anteriorly near the Sternum, and end posteriorly at the Angle of each Rib.

Therefore, between these Angles and the Cartilages, these musculous Planes are double; the Fibres, by their opposite Directions, representing the Letter X: But from the Vertebrae to the bony Angles, and in the Interstices between the cartilaginous Portions, the Plane is single, being that of the external Muscles posteriorly, and of the internal anteriorly.

The Fibres of the external Intercostals are very oblique near the Vertebrae; but this Obliquity decreases insensibly towards the anterior Extremities of the Ribs: Their Insertions begin at the Ligaments by which the Ribs are fastened to the trans-

verse

verse Apophyses. They are a little tendinous, and run for a small Space beyond the Margin, on the external Side of each Rib.

The Fibres of the internal Intercostals are, in general, shorter, and less oblique, than the former: They fill almost entirely the Interstices between the cartilaginous Portions, and are covered externally by a ligamentary Membrane, the Fibres of which, running in an opposite Direction to those of the Muscles, have been mistaken for Continuations of the external Intercostals, over which this Membrane is likewise spread, only a little diminished in Thickness.

Any Portion of the Thorax of an Animal may be boiled so much, as that the Flesh shall easily part from the Bones; and the Ribs may be drawn out, disordering neither the Muscles nor Membranes. But we are not from thence to conclude, that all the Intercostals, on one Side of the Thorax, make but one Muscle; because, by the same way of Reasoning, it might be proved, that all the Muscles which immediately surround the Os Femoris are but one: Since, by a like Experiment, they, together with the Periosteum, may be entirely separated from the Bone, without breaking their Fibres.

The SUPRA COSTALES, commonly called LEVATORES COSTARUM, which Name was given them by STENO, but he did not pretend to have discovered them; they are irregularly triangular, and situated on the posterior Part of the Ribs, near the Vertebrae.

Each of these Muscles is fixed, by one tendinous Extremity, in the transverse Apophysis which lies above the Articulation of each Rib, and to the adjacent Ligaments; the first being inserted into the transverse Apophysis of the last cervical Ver-

tebra, and the last into that of the eleventh Vertebra of the Back.

From thence the musculous Fibres run inferiorly oblique, increasing in Breadth as they descend, and are inserted into the posterior Part of the external Side of the following Rib: Some of the Fibres often pass beyond that Rib, and are fixed, in one or more of the Ribs below it, by several Digitations, which lie at a greater Distance from the Vertebrae in Proportion as they run inferiorly; in the inferior Ribs these Digitations are more considerable than in the superior.

The SUB COSTALES are musculous Planes of different Breadths, and very thin, situated more or less obliquely on the internal Sides of the Ribs near their bony Angles, and running in the same Direction with the external Intercostals.

They are fixed, by both Extremities, in the Ribs; the inferior Extremity being always at a greater Distance from the Vertebrae than the superior, and several Ribs lying between the two Insertions.

These Muscles are more visible in the inferior Ribs than in the superior; and they adhere closely to the Ribs which lie between their Insertions.

The STERNO COSTALES, vulgarly TRIANGULARIS STERNI, are five Pairs of musculous Laminæ, disposed more or less obliquely on each Side the Sternum, on the internal Side of the Cartilages of the second, third, fourth, fifth, and sixth true Ribs.

They are inserted, by one Extremity, into the internal Margins of all the inferior Half of the Sternum; from thence the first Muscle, on each Side, runs oblique superiorly, and is fixed in the Cartilage of the second Rib; the second runs less obliquely to its Insertion into the Cartilage

tilage of the third Rib; the rest are inserted, in the same Manner, into the Cartilages of the following Ribs; their Obliquity decreasing, and their Length increasing, in Proportion as they are situated lower down; so that the lowest is almost transverse.

This last Muscle, which is fixed by one Extremity in the Cartilage of the sixth true Rib, near the Bone, and seems to pass the Appendix Eniformis immediately above the Insertion of the Diaphragm into that Appendix, and to join the Muscle on the other Side. The superior Portions of the transverse Muscles of the Abdomen, united with the inferior Sterno Costales, have nearly the same Appearance; so that these might be reckoned to belong to the Transversales, did not the Insertion of the Diaphragm come between them.

USES OF THE MUSCLES EMPLOYED IN RESPIRATION.

In describing these Muscles, we began with the DIAPHRAGM; but its Use will be described last.

The SCALENI seem better fitted for the Motions of the Neck, than for those of Respiration.

The SERRATUS POSTICUS SUPERIOR is disposed to move upwards the three or four superior Ribs next the first; and if any Portion of this Muscle should be observed to be inserted into the first Rib, that could only serve for the Motion of the Vertebræ with which that Rib is articulated, and not for the Motion of the Rib itself, because of the Stiffness and Immobility of its cartilaginous Portion.

The SERRATUS POSTICUS INFERIOR is still better disposed for depressing and keeping down the last three or four false Ribs.

The Use which has been assigned to these two Muscles, of being Vaginæ or moveable Fræna to the Longissimus Dorfi and Sacro Lumbaris, is without Foundation; for the Portions of these Muscles, covered by the Serrati, have no more Need of such a Contrivance, than those which are not covered by them.

The posterior Fibres of the external INTERCOSTALS are fixed, by their superior Extremities, so near the Articulation of the Ribs with the Vertebræ, that they cannot depress that Rib into which they are so inserted; whereas the Insertions of their inferior Extremities into the following Rib, being at a greater Distance from the Articulation, they may move that Rib upwards: And from thence it follows, that all the remaining Part of each external Intercostal, which terminates at the osseous Extremity of each Rib, can only serve to raise the inferior Rib towards the superior.

The anterior Fibres of the internal INTERCOSTALS are so near the Articulation of the Ribs with the Sternum, that they cannot depress that Cartilage into which each of them is inserted; whereas the inferior Insertions of these Fibres, being at a greater Distance from the Articulation, they are in a Condition to raise the Cartilages into which they are so inserted: From whence it follows, that all the internal intercostal Muscles have the same Use with the external; and that they can have no other.

The Portions which lie between the two Extremities of the Ribs, serve to increase the Force of the same uniform Action: And the first Rib, being immoveable, serves for a fixed Point for the Motions of all the other Ribs; and each Rib, in particular, serves for a fixed Point for the Motion of that below it.

The SUPRA COSTALES are powerful Assistants to the Intercostals, in their common Action; and are, therefore, very properly termed LEVATORES COSTARUM.

But we must not confound with these, a small Muscle immediately above the first Rib, which, by its Insertion into that Rib, looks like them, at first Sight.

The Insertions and Direction of the STERNO COSTALES, being carefully examined, it will be found, that their Use is, to depress the cartilaginous Portions and anterior Extremities of the Ribs, especially the superior ones, except the first; and, at the same Time, to draw the Cartilages of the inferior Ribs near to the Sternum, by reason of the Curvature. They may, therefore, very well be called DEPRESSORES COSTARUM, as the Supra COSTALES are named LEVATORES.

The SUB COSTALES have the superior Extremities of their Fibres much more distant from the vertebral Articulations of the Ribs than the inferior ones: Whence it follows, that they can more easily move the superior than the inferior Ribs; and, consequently, that they are Assistants to the Sterno Costales.

The DIAPHRAGM, together with the INTERCOSTAL MUSCLES, RIBS, STERNUM, and DORSAL VERTEBRÆ, form the Cavity of the THORAX; and it divides this Cavity from that of the ABDOMEN.

Its particular Use is, to be the principal Organ of Respiration; that is, of the alternate Expansion and Contraction of the Thorax.

The other Muscles, already mentioned, are to be considered only as Assistants and Directors, in order to facilitate and regulate the Motions which, in the ordinary State, are perpetual; but which may, by the Action of these other Muscles, be

accelerated, retarded, or even suspended, for some Time.

The Diaphragm may move when the Ribs are at Rest; and, consequently, without the Assistance of the Muscles which move the Ribs; and this Motion may be sufficient to keep up the alternate Dilatation and Contraction of the Thorax; without which, an Animal cannot live.

In a Word, we may continually inspire and expire, by means of the Diaphragm, whether the Ribs move, or remain at Rest; and whether the Thorax be kept, for a considerable Time, in a State of great Dilatation, or great Contraction: For this does not hinder the Diaphragm from continuing its Motions.

OF INSPIRATION AND EXPIRATION.

The Quantity of Blood which enters the Lungs is exceeding great; equal to (or even, perhaps, greater than) that which is sent, in the same Time, throughout the rest of the whole Body: Which therefore demonstrates some very considerable Uses proper to this Viscus.

And that this Use depends manifestly upon the Air, appears, from the universal Consent of Nature; in which we scarce find any Animal without Breathing: Also, from the Structure of the Lungs in a Fœtus; in which, for want of Air, they are useless; receiving only a small Portion of the Blood which the pulmonary Artery conducts from the Heart.

We shall now, therefore, speak of the Nature of Respiration; by which the Air is drawn into, and expelled from, the Lungs.

The Element of Air appears, from the Principles of Philosophy, to be an elastic, invisible, and sonorous Fluid; but the atmospherical Air,
which

which we commonly receive into the Lungs, is impure, filled with a great Quantity of aqueous Vapours, the Seeds of Plants and Animals, and other heterogeneous Bodies, but in very minute Particles; so that its specific Gravity is about 850 Times less than that of Water.

This Air, which surrounds the Earth on all Sides, being pressed by the incumbent Columns of its own Mass, perpendicularly, laterally, and in all possible Directions; enters, wherever it meets a less Resistance, with a considerable Force; as appears, from Experiments made with empty or exhausted Vessels, and by the Air Pump.

This Air is excluded from all Parts of the human Body by the surrounding close Skin, which, even when dried, or tanned, is impervious to the Air; but more so as under the Skin is placed the Fat, making an equal Resistance to the narrow Openings of the absorbing Vessels.

It therefore now remains for us to enquire, Why the Air enters the Lungs of an adult Person? For with this they are, in a Manner, constantly full; and, consequently, are equally pressed, and resisting the Weight of the whole Atmosphere. But that the Lungs always contain Air, is evident; because, how close soever you compress them, they will still be specifically lighter than Water; and even in a Foetus, after they have been inflated but a small Number of Times, they always swim: Whereas, before Breathing, they sink in Water, if they have not, as yet, given Admittance to the Air.

The Equilibrium of the Air's Pressure being removed in any Place, it constantly descends or flows that Way where it is least resisted: Therefore, for the Air to enter the Lungs, they must make a less Resistance to it than before; namely, the Air, which is already in the cellular Fabric of
the

the Lungs, must be rarefied : But this Effect will follow, if the Cavity of the Thorax, in which the Lungs are contained, and which they exactly fill, be dilated. Thus the Air, which is always in the Lungs, expands into a larger Space ; by which means, being weakened in its Spring, it makes a less Resistance to the external Air ; and, consequently, a Portion of the said external Air descends into the Lungs sufficient to restore the confined and rarefied Air, filling the Lungs to the same Density with that of the external Air.

We have hitherto surveyed the Powers which are able to increase the Capacity of the Thorax in all its Dimensions ; it therefore remains, that the Air, which is a heavy Fluid, and pressed on all Sides by the incumbent Columns of the Atmosphere, must now enter the Thorax or Lungs by the greater Force which it has over that little rarefied Air already in the Lungs ; or yet more powerfully, if they contain no Air at all. In this Action, therefore, which is called Inspiration, the Bronchia, or Branches of the Wind-pipe, are every way increased, both in Length and Diameter ; because all the Diameters of the Thorax are increased : But, in this Act, the inflated Lungs always follow closely contiguous to the Pleura, without leaving any intermediate Space : At the same Time the pulmonary sanguineous Vessels, which are wrapped up, together with the Bronchia, in a Covering of the cellular Substance, are likewise, with them, extended in Length, and spread out from smaller into larger Angles ; by which means, the Circulation thro' them is rendered easier. Whilst this is performing, the vesicular Substance, or Flesh of the Lungs themselves, filled with Air, increases those Spaces thro' which the capillary sanguineous Vessels of the Lungs make their Progress ; whereby the vesicular
Pressure,

Pressure upon each other, and upon the adjacent Vessels, is diminished: Thus, therefore, the Blood will flow, with a greater Celerity, into and thro' the larger and smaller Vessels of the Lungs. Hence, we observe, the Pulse is quicker, during the Time of Inspiration. But as for the Pressure of the Air upon the Blood in the Lungs, in this Action, it is so inconsiderable, as not to deserve our Notice*.

It is doubted by some, whether there be not Air between the Lungs and Thorax; and whether this Air, being rarefied in Inspiration, is not afterwards condensed, so as to compress the Lungs, and cause Inspiration. And they again ask, Whether this Opinion be not confirmed by the Instances of Birds, in which we find this Matter to be truly so? But we see every Thing concurs to confute this Opinion.

For, 1. Immediately behind the Pleura, in living Quadrupedes, as well as in dead human Bodies, the Lungs are contiguously visible to the naked Eye, without any intermediate Space between them; but, the Pleura being perforated, the Lungs are immediately, by the contiguous Air that enters, pressed together towards the Vertebrae.

2. Large Wounds, admitting the Air only into one Cavity of the Thorax, diminish Respiration; but such Wounds as let the Air into both Cavities, quite suffocate or suppress Respiration.

3. The Thorax, being opened under Water, sends out no Bubbles of Air thro' the said Water.

Again, 4. The imaginary Space between the Lungs and the Thorax is always filled with a

* The Pressure of the Atmosphere is never (naturally) so much increased, as to urge the Air through the Pores of the Lungs into the Blood, as it may easily be forced, by Art, with a Syringe; although some of the Air may be substantially expelled or absorbed this Way, as it is in common through the Pores of all other Bodies, whilst it approaches to a solid or fixed Plate.

watery or serous Vapour, or else by the same Vapour condensed into a watery Lymph.

5. If the Lungs adhere, they injure Respiration but in a small Degree; which ought entirely to cease, if it requires an intermediate Air between the Lungs and Thorax.

6. Finally, The external Air, being admitted into any of the internal Membranes of the human Body, destroys their Texture, if they are not defended by a plentiful Mucus; of which we can find none, either upon the Surface of the Lungs, or of the Pleura.

After the Thorax has been every Way dilated, by the said Powers, as far as it well can be, or as far as is sufficient for the Purposes of Life and Death; the Air, thus received into a Place constantly near thirty Degrees hotter than itself*, grows warm there from the Blood, from which it acquires about fifteen Degrees of Heat: Therefore the Air, thus expanding the Cells to their utmost Extent, whose Dilatation, at the same Time, meets with no empty Space in the Thorax; the Blood, thereupon, begins to be stopped, by the Air's Expansion (being then rarefied and expanded to a twelfth Part of its former Bulk), compressing the least Vessels; by which means, a new Resistance arises to the Blood, perpetually flowing from the Heart into the Lungs: And therefore we see, in hard Straining, and long Retentions of the Breath, the Blood stagnates in the Veins, especially about the Head, before the right Side of the Heart, which is now shut, because unable to empty

* The middle Degree of the Air's Heat, in the northern Countries of Europe, mounts the Thermometer to about 48 Degrees, while the mean Heat of the expired Air from the Lungs is 94 Degrees; of which, the Difference, 46 Degrees of Heat, is gained by the Air from the Blood; since the Breath seems to have the same Heat with the Lungs, in its Contact.

itself into the Lungs; whereupon the Face swells, looks red, and sometimes the Veins of the Brain, Neck, Intestines, Kidneys, Lungs, or even the right Auricle itself, will be bursted with Violence.

Such is the Cause of Death, in those who are suffocated by compressed Air, by drowning in Water, or by strangling with Cords. Therefore that Anguish or Uneasiness which arises from the Stoppage of the Blood in its Course through the Lungs of a healthy Person, is the Occasion which excites him to open or relax again the Powers of Inspiration, and immediately to stir up the Forces which concur to Expiration, thereby to free the Thorax and Lungs from the too much rarefied Air.

The Powers concerned in Expiration are, chiefly, the oblique Muscles of the Abdomen, together with the Recti and transverse ones. The former of these are, in one Part of them, fastened to the inferior Ribs; and, in another Part, they are attached to the Os Pubis and Ilium, as a fixed Point with Respect to the Breast: Therefore the Musculi Recti, being contracted, depress the Arch or Convexity into which the abdominal Viscera are thrust by the Diaphragm, and bring the same nearer to a strait Line; and, at the same Time, the abdominal Viscera are pressed by those Muscles, superiorly and posteriorly, against the Diaphragm, which, alone, is able to give way and yield up into the Thorax, which, at that Time, is rendered shorter. The oblique Muscles, for the same Reasons, compress the lateral Parts of the Abdomen, and urge the Liver, Spleen, and Stomach, superiorly; and, lastly, they draw down the Ribs, which were before elevated by the Intercostals. The transverse Muscles, indeed, do not draw down the Ribs; but they pull the Cartilages of the false Ribs a little internally, and render the whole Capacity

capacity of the Abdomen less; whilst, at the same Time, they urge the Viscera against the Diaphragm. By these Means, the Thorax, contrary to its former State, is every way rendered narrower and shorter, so as to expel as much Air out of the Lungs as is sufficient to relieve the Uneasiness caused by its Retention. At the same Time, the muscular Fabric of the Bronchia exerts a Power of Contraction against the distending Air, so as to promote its Expulsion; and the Ribs themselves likewise returning, by their Elasticity, to that Situation and Rest which their Articulations require in a State of Expiration, do all of them fly upwards together, as soon as the extending Powers cease; whereupon, their Elasticity restores them spontaneously to their respective Places, during Expiration. From hence Expiration becomes easier than Inspiration, and quicker in the Proportion of two to three; and from hence it remains always as the last Act in a dying Person. The triangular Muscle, also, of the Sternum, by elevating the Cartilages of the true Ribs, together with the Sternum itself, which they draw upwards and backwards, has some small Share in this Action.

In a more powerful Respiration*, when the Inspirations are made wilfully greater, the Expirations are likewise increased by the Assistance of some other Powers, as the *Sacro Lumbalis*, *Longissimus*, and *Quadratus Muscles* of the Back and

* We are very sensible, that, in Efforts where great Strength is requisite, we suspend Respiration, in retaining as much Air as possible in the Lungs, and by the extreme Tension of all the Organs subservient to Respiration at that Time, that we explain how the Italian Woman, seen in London, could bear so great a Weight upon her; and the Man, I saw at Paris, lying on a Plank supported only at both Ends, and having on his Breast an Anvil of six Hundred Pounds Weight; and suffers a Bar of Iron to be beat on the Anvil with large Hammers.

Loins. This Force, by which the Air is blown out of the Lungs through a Tube, is sufficient to carry a leaden Bullet, weighing above a Dram, to the Distance of one Hundred and Sixty Yards; but, in a healthy Person, the Muscles of the Abdomen alone suffice to an easy Expiration, in which the Lungs are not so much emptied of Air as they are by a violent Efflation.

The Effects of Expiration are, a Compressure of the sanguiferous Vessels in the Lungs, a Reduction of the Bronchia or Branches of the Wind Artery into more acute Angles, a Pressure of the reticular small Vessels by the Weight and Contact of the adjacent larger Vessels; by which means Part of the Blood, hesitating in the capillary Arteries, is urged forwards through the Veins to the left Side of the Heart; whilst, at the same Time, that Part of the Blood is resisted which flows in by the Artery from the right Ventricle. For we see, by Experiment, that if the Lungs are not inflated, they are never well filled by Injections, which always succeed best, by causing the Lungs to imitate vital Respiration*.

In this Manner a fresh Necessity follows for repeating Respiration; because the collapsed Vessels of the Lungs resist the Blood repeatedly expelled from the right Ventricle of the Heart; and this makes another Cause of Death in those Animals which expire in Vessels exhausted of Air. For in such, the Lungs, having the Air drawn out from them, appear dense, solid, and heavier than Water; whence they are rendered impervious to the Blood. Of the same Kind is the Death of those who are

* Does not, therefore, the Blood seem to flow quicker thro' the Lungs, than thro' other Parts of the Body? And is not this made probable, from the Quantity of Blood, and the Shortness of its Course, in going from the right to the left Ventricle.

destroyed by Lightning. Thus, therefore, by the Power of a most wise Fabricature, the Organs of Expiration are relaxed, as soon as that Uneasiness is perceived which arises from the Hindrance of the Blood's Course thro' the Lungs; and, thereupon, the Powers of Inspiration are excited to Action, whereby the Course of the Blood through the Lungs is rendered free and quicker*.

It is by some questioned, Whether there are not other Causes of alternate Respiration? Whether we may hope for any Discovery in this Matter, by compressing the Vena Azygos, the phrenic Nerve; or intercepting the Blood sent to the Brain? But those are repugnant to comparative Anatomy; by which we always find the same Alternation in the Breathing of an Animal, independent of any such Nerve or Vein. Whether Respiration is from the alternate Contraction of the antagonist Muscles, among which those of Expiration relax the others of Inspiration, and the contrary? But, in this Manner, all the Muscles of the human Body are perpetually in an alternative Motion.

From what has been hitherto said it appears, that Respiration is unavoidably and absolutely necessary to Life in a healthy adult Person: Because, whether the Lungs remain long in a State either of Expiration or Inspiration, we see that Death will be the Consequence. Therefore no Animal, that has Lungs like ourselves, after it has once breathed, can subsist longer than a few Minutes without the Use and Benefit of a free Air; but it will either perish, or, at least, fall into such a State as differs

* A dense Air will preserve Life much longer than that which is rarefied; because the former more easily and spontaneously enters and distends the Lungs; whilst the latter, being unable to overcome the Resistance of the Air Vessels and confined Breath, is excluded: Yet a healthy Person can, without much Difficulty, support any Air that has but Half the common Density of the Atmosphere.

from Death only in its being recoverable again by certain Powers or Actions.

But the Use of Respiration is different from this Necessity, which Nature might have avoided, either by using no Lungs at all, or else by disposing them in a Manner resembling those of a Fœtus. This Use, therefore, of Respiration, must be very considerable; since all Animals are either made with Lungs, or Gills, as in Fishes; or else with a Wind-pipe dispersed through all Parts of the Body, as in Insects.

In order to discover this immediate Usefulness of Respiration in Man, let us compare the Blood of an adult Person to that of a Fœtus, and also with the same vital Fluid in Fishes. It appears, then, in a Fœtus, that the Blood is destitute of its florid Redness, and solid Density; and in Fishes we observe, that there is neither Heat nor Density, and but little Crassamentum contained in it; and therefore all these Properties, we are, by the Nature of Things, persuaded, the Blood acquires in the Lungs.

It follows, therefore, that our Blood acquires its Heat, principally, in the Lungs; for that all Animals, which have Lungs, and two Ventricles in the Heart, have the Heat of their Blood commonly twice as great as that of the Atmosphere*. But does not this arise from the alternate Extension and Contraction, Relaxation and Compression, of the pulmonary Vessels, by which the solid Parts

* Thus, in the same northern Seas, we observe, that those Fishes, which have no Lungs for Breathing, are as cold as the Element, although their Flight and Motion through the Waters be ever so strong and rapid; but, at the same Time, those of the Whale Kind, which breathe with Lungs, have their Blood warm, like that of a Man, although they remain almost ever sleepy and sluggish. Neither the Heart, therefore, nor all the rest of the Body, are able to generate the Heat of the Blood without the Assistance of the Lungs.

of the Blood are perpetually rubbed together, and closely compressed in the Attrition that is made during Expiration, as it is more rapidly moved and ground together during Inspiration.

Nor is it any Objection to this, that Water cannot be made to grow hot by any Friction: Nor, in Reality, is that Assertion true. For Water, by violent Winds and Motion, as well as Milk, acquires some Degree of Warmth; and the Blood, which is so much more elastic and inflammable than Water, must, of Course, acquire a much greater Heat. Nor does the Heat of the Blood proceed from an Effervescence: For only the muscular Motion being increased, or even merely by an increased Use of the Organs of Respiration, the Heat of the Blood is augmented; as it is diminished in Proportion as those Actions are diminished, and soon ceases when they are wholly suppressed.

The Density of the Blood is, indeed, again promoted in the Lungs, partly by the copious Discharge of the aqueous Vapour, which is there separated, and expelled from the pulmonary Vessels, by which the rest of the Mass will become specifically heavier; but the same Effect seems to follow, more especially, from the Attrition and Pressure which the Blood here suffers in being alternately retarded, accelerated, and figured, in its Course through the modulating Tubes of the least Vessels, which give a Sphericity and Density to the Particles. And, in this Respect, the pulmonary Vein, being smaller than its corresponding Artery, is of no small Use towards increasing the Attraction of Cohesion between the Parts of the Globules, so as to compress and bring them closer to each other.

But it is well known, by the Experiment of Sir ISAAC NEWTON, that Redness is increased by a
greater

greater Density of Particles: From hence it is, that the Redness, Heat, and Density of the Blood, are always proportionably increased together by muscular Motion, or Exercise, with which the Motion of the Lungs, in Respiration, necessarily corresponds and increases*.

It is therefore queried by some, Whether the Air itself is not received by the Blood in the Lungs, so as to excite necessary Vibrations therein? Whether this does not appear from the Resistance of Bodies to the heavy external Air, and from the Air found in the Blood Vessels, in the cellular Substance, and certain Cavities of the human Body? Also, from the Cracking observed by an Extension of the Joints? To which add, the Air manifestly extravasated from the Wind-pipe into the Hearts of certain Animals, as the Locust; together with the Necessity of a vital Oscillation in the Blood itself? And, lastly, the increased Redness of the pulmonary Blood?

Contrary to all this, it is evident, that the Blood here receives no Air into itself; partly from the Minuteness of the inhaling Vessels, with the Mucus that perpetually lines the Sides of the Vesicles in the Lungs; to which add, the Nature of the elastic Air itself, which is very unapt to pass thro' capillary Vessels, with a Repulsion of it by Water, which hinders it from passing thro' Paper, Linen, Cloth, or Skins, which are wetted by Water.

Again; the Air, being driven into the Wind-pipe, never passes to the Heart; or, whenever it does, it is forced thither by some great or unna-

* But that there is some small Difference between the Blood of the Lungs and that of other Parts, is argued from many Experiments; and, particularly, extreme Cold there condenses the Blood, in some Degree. Add to this, its Difference from the thin, aqueous, and light Blood of Fishes.

tural Violence: But the permanent Air in the Vessels and Humours of the human Body, from a State of Inelasticity, may become elastic by Putrefaction, Frost, or an external Vacuum: But such permanent unelastic Air is incorporated with all Liquors, and taken into our Bodies with the Aliments and absorbed Vapours mixing slowly, and with some Difficulty. But there never were any elastic Bubbles of Air observed in the Blood of a living Animal; and such Air, being inflated into the Blood Vessels of any living Animal, kills it speedily. Nor is there any Certainty of the Blood in the pulmonary Veins being of a brighter red Colour.

Whether the Blood is cooled in the Lungs; and whether this seems to be true from the Death of Animals in Air which is heated to such a Degree as equals the Heat of the hottest Breezes in the most sultry Dog Days? And whether the pulmonary Veins are not, therefore, less than the Arteries? That the Blood is cooled in the Lungs, is thus far true; in that it there communicates fifteen Degrees of its Warmth to the contiguous Air.

But that this was not the principal Design of Nature here, upon the Blood, is evident; since no one will say, that the venal Blood is hotter than the arterial; although some pronounce the former to be somewhat cooler. Since, therefore, the venal Blood enters the Lungs; if it be there cold, it will follow, that the Arteries must receive it still colder.

But, then, here the Degrees of Heat, which the Blood communicated to the Air, are again recovered by it; and, indeed, a Man may live in an Air much hotter than the Blood itself. We see, that the greater Capacity of the right Ventricle and pulmonary Artery was necessary to reserve and
retard

retard the Blood, as the pulmonary Vein, being narrower, accelerates it.

Whether the Use of the Lungs is, to absorb a Nitre, from the Air, to the Blood? or Whether the florid Colour, observable on the Surface of a Cake of Blood, be owing to the same Cause, while the inferior Part looks of a dark and blackish Colour? remain Questions, with some.

That there is a kind of volatile Acid in the Air, is certain; since that, meeting with a suitable Earth, forms Nitre. For a nitrous Earth, being exhausted of its Salt, and exposed again to the Air, becomes impregnated with more Nitre: But the same universal Acid, we know, by certain Experiments, meeting with a different Sort of Earth, forms a vitriolic Salt, or else Sea Salt. For the Caput Mortuum of Sea Salt, which remains after the Distillation of the Spirit, recovers so much Strength from the Air, as enables it to yield more Spirit by Distillation; even in Snow there is a cubical Salt, but Marcasites sweat out a true Vitriol, and Colcothar recovers again the acid Spirit which was drawn from it: Also, fixed Alkali, exposed to the Air, turns into a vitriolic Tartar.

This, therefore, cannot be the Use of Respiration; because those Salts abound in too small a Quantity of Air for such Uses: And that Air is fittest for Breathing which is (perhaps) on the Tops of the highest Mountains, where those Salts are to be found in the least Quantities; nor is there any nitrous Salt, as yet, known to be found in our Blood.

As for the superior Part of the Surface of the Cake of Blood appearing of a bright florid Colour; that arises from a Relaxation or looser Disposition of the spherical Globules there, while the inferior Part appears black; because the Globules
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are there more compressed and condensed by the other incumbent Parts.

If it be asked, Why Tortoises, Frogs, Lizards, Snails, Earwigs, and other Insects, live long without Air? We answer, That in them the Lungs are given not so much for the Preparation of the Blood, which they receive but in a very small Quantity, as for the Use of Swimming: And from hence it is that their Lungs are immediately joined with the Vena Cava and great Artery. But Insects, we know, draw the Air in, and exhale it again thro' their Skin. If it be asked, Why all Animals perish in Air that is confined, or not renewed, altho' the Animal be small; such as little Birds? We answer, Because the Air which has once entered the Lungs, and been made foul by aqueous Vapours, is rendered less elastic, and unfit for Respiration, by alkaline Vapours. Hence it is, that an Animal survives longer in Air that is more compressed than that of the Atmosphere: For, in that Case, there is a greater Proportion of the elastic Element, which takes up a longer Time to be corrupted. But, even in other Cases, confined Air is rendered destructive only by Stagnation, and filling it with Vapours: And the Reason why Animals swell in an exhausted Vessel, is, from the Extrication and Expansion of the unelastic Air lodged in the Blood and other Juices.

There is a certain Consent or Proportion between the Pulse and Respiration; that, according to the common Course of Nature, there are three or four Pulses counted to one Respiration: But if more Blood is sent to the Heart, in a given Time; the Numbers, both of the Pulse and Respiration, are increased. This is the Cause of panting or short breathing in a Person that exercises his Body with any considerable Motion, whereby the venal Blood is returned faster to the Heart. But if the Blood

meets with a greater Resistance in the Lungs, so that it cannot pass freely from the right to the left Ventricle of the Heart; then the Respiration is increased, both in Number and Magnitude, to forward its Course; and this is the Cause of Sighing and Yawning. If it be asked, Why an Animal, that is dying, may be recovered again to Life, by inflating Air into the Lungs? We answer, That the proximate Cause of Death is, too great a Resistance opposed to the Course of the Blood through the Lungs, whereby it cannot pass to the Aorta: But, by inflating the Lungs, that Resistance is removed, and the Way opened for the Blood to pass.

The Mucus, which lines the sensible Membranes of the Air Vessels in the Lungs, may become troublesome, both by its Quantity and Acrimony: It has been even known to cause Suffocation in a Dropsy of the Lungs. Therefore its Quantity, Adhesion, or Acrimony, excites a Cough; namely, an Irritation of the respirative System, by alternate large Inspirations, succeeded by large and quick Expirations, together with sudden Shocks of the abdominal Muscles; by which the Mucus, and sometimes calculous Matters, are expelled from the Lungs.

Laughing differs from Coughing in its Cause, which resides commonly in the Mind, or, at least, consists in a certain Titillation of some of the cutaneous Nerves; and, moreover, because it is made up of imperfect quick Expirations thro' the contracted Glottis, after one large or deep Inspiration: Nor is the Air perfectly evacuated from the Lungs in Laughter, which, in a moderate Degree, conduces to Health; because, to one full Inspiration, are joined many shaking Expirations, agitating the Blood. But much of it is in Danger of stagnating the Blood, because the Expiration is not full, or entire; whereby the Blood is admitted into the
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pulmonary Artery without being suffered to pass through it. Weeping has short Respirations like those of Laughter, but finishes with a deep Expiration that is immediately joined by a large Inspiration; whence it has nearly the same good and bad Effects; and, when moderate, it conduces to relieve the Anguish arising from Grief. Sneezing consists of one large or deep Inspiration, which is followed immediately with a powerful and sudden Expiration.

The additional or secondary Uses of Respiration are many*. It is by this Force that the Abdomen, with all its Viscera, are continually compressed; by Virtue of this, the Stomach, Intestines, Gall-Bladder, Receptacle of the Chyle, Urine-Bladder, Intestinum Rectum, and the Womb itself, discharge their Contents; by this Action the Aliments are principally ground or dissolved, and the Blood is urged through the sluggish Vessels of the Liver, Spleen, and Mesentery: It moreover serves to convey Odours thro' the Air to the Organs of Smelling. By this the Air is mixed with the Aliments, which it conduces very much to break and dissolve, towards a perfect Digestion. And even Sucking, so necessary and natural to a new-born Infant, is made by the Use of Respiration; forming an ample Space in the Mouth, in which the Air is rarefied; so that, by the greater Pressure of the external Air, the Milk is driven into that Part where it is least resisted.

Lastly, The Voice itself is owing to the Air which we breathe. HALLER. Prim. Lin. Physiol.

* It exhales, as an Emunctory, the redundant and even noxious Particles from the Blood, which, in confined Air, suffocates.

